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HUMAN VISION AND THE SPECTRUM

By Professor GEORGE WALD¹

BIOLOGICAL LABORATORIES OF HARVARD UNIVERSITY

THE basic relation which describes the response of the eye to radiation is its sensitivity to the various wave-lengths of the spectrum. The limits of this function define what is meant by light. Its form expresses fundamental properties of the retinal receptors, and of the ocular structures which light must penetrate to reach them.

The human retina contains two groups of receptors:

¹ This research was supported in part by a grant from the Josiah Macy Jr. Foundation. Part of the work was reported to the Optical Society of America at its meeting in October, 1944 (*Jour. Opt. Soc. Amer.*, 34: 769, 1944). The remainder was to have been reported to the society at its meeting in April, 1945, since cancelled. Most of the experiments on aphakic eyes were performed in the summer of 1943 at the Dartmouth Eye Institute, Hanover, N. H., to whose director, Professor Adelbert Ames, Jr., and ophthalmologist-in-chief, Dr. Hermann Burian, I am most grateful. I wish to acknowledge also the technical assistance of Ruth Hubbard with some of the experiments.

rods, which function in dim light; and cones, the organs of vision in bright light, and color vision. The rods are mainly sensitive at lower wave-lengths than the cones. Hence, in the passage from dim to bright light, the spectral sensitivity of the eye shifts toward the red. This is the Purkinje phenomenon.

A small central area of the human retina—the fovea—which subtends a visual angle of about 1.5°, contains only cones. Within this region, therefore, no Purkinje phenomenon is observed.² Even in the dark-adapted eye, in which all peripheral responses are dominated by rods, the fovea retains the characteristics of pure cone vision.

The intrinsic sensitivities of rods and cones are

² A. Kohlrausch and J. Teuffer, *Tab. Biol.*, 1: 309, 1925; K. Gross, *Z. Sinnesphysiol.*, 59: 215, 1928; S. L. Polyak, "The Retina," Chicago, 1941, p. 202.

modified by the presence of colored intraocular structures. One of these is the lens, which in man is yellow in color. The cornea and the ocular humors also absorb some light in the violet and ultra-violet. The optical properties of these structures affect the spectral sensitivity of the whole eye.

In man and certain other primates, the retina itself contains a yellow pigment, concentrated in a diffuse central zone about the fovea, the *macula lutea*. This pigmentation imposes special differences in spectral sensitivity upon the central as compared with the peripheral retina.

Repeated measurements have been made of the spectral sensitivity of human vision, either in bright light, involving principally macular cones; or in dim light, involving macular or paramacular rods. The present investigation includes somewhat comparable measurements, performed under conditions of precise fixation, of the spectral sensitivities of foveal cones and of rods well outside the macula.

To these are added three functions not previously described: the spectral sensitivities of peripheral cones, and of rods and cones in the lensless (aphakic) eye. The differences in sensitivity of central and peripheral cones, and of normal and aphakic eyes, yield estimates of the absorption of light by the macular pigment and by the lens. The pigment of the human macula has also been extracted, and certain of its optical and chemical properties have been examined directly.

In these experiments the spectral sensitivity has been determined by measuring at various wave-lengths the absolute threshold of vision—the smallest radiant flux that can be seen. The simple reciprocal of this quantity is the sensitivity.

To measure thresholds a spectral adaptometer was constructed which employs as source a high-pressure mercury arc.³ From its radiation, ten spectral lines or narrow bands are isolated with color-filters. The intensity at each wave-length is regulated with an annular neutral wedge. A variable fixation point permits the image of the test field to be located foveally or at any point within 12° of the foveal center. A shutter exposes the field for flashes of 1/25 second. In all the experiments to be described, the field was circular, and subtended a visual angle of 1°. All measurements were monocular and ordinarily were performed on alternate eyes.

FOVEAL CONES

The image of a 1° test field, fixated centrally, should fall entirely within the fovea, and should stimulate only cones. Measurements made with such a stimulus in the dark-adapted eye are shown in Figs. 1 and 2,

³ G. Wald, *Jour. Opt. Soc. Amer.*, 35: 187, 1945.

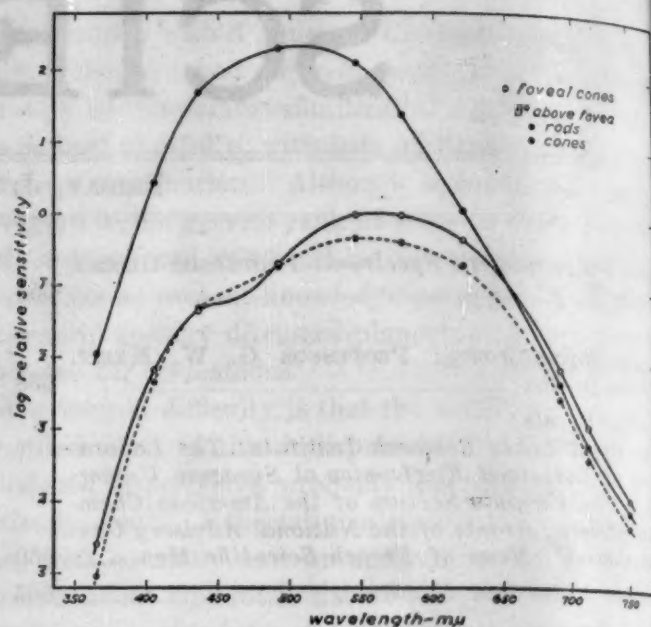


FIG. 1. Spectral sensitivities (1/threshold) of dark-adapted foveal cones, peripheral rods, and peripheral cones (broken line). All sensitivities are expressed relative to the maximum sensitivity of the fovea. The relative positions of these functions on the ordinates are therefore those observed in the eye.

and in Table 1. They represent averages for 22 observers of average age 20. Thresholds and sensitivities are expressed logarithmically to do justice to the huge range of the measurements.

The maximum sensitivity of the fovea, here arbitrarily set at 1 (log sensitivity = 0), occurs at about 562 mμ. To both sides of this wave-length it declines, reaching on an average about 1/10,000 of its maximum value at 750 mμ, and about 1/40,000 at 365 mμ.

That these data are in fact due to cones is attested

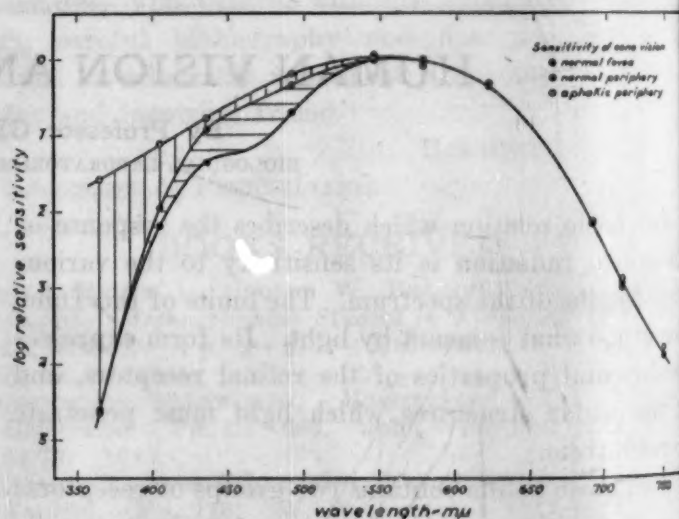


FIG. 2. Spectral sensitivities of cone vision in the normal fovea, and in an area 8° above the fovea in the normal and aphakic eye. All these functions have been brought together above 578 mμ, where all of them are parallel. The horizontally hatched area represents the optical density (log 1/transmission) of the macular pigmentation in the fovea, the vertically hatched area the density of the lens.

by the following considerations: (1) Dark-adaptation measurements performed at various wave-lengths show that the threshold falls within 4-6 minutes to a constant level, maintained indefinitely thereafter. The threshold stimulus continues to look colored at all wave-lengths. This behavior is characteristic of cone vision. (2) A 1° field fixated centrally has previously been shown repeatedly to reveal no trace of a Purkinje phenomenon.⁴ (3) The present data agree well with previous measurements of the spectral sensitivity of central areas at high brightnesses—so-called photopic luminosities.⁵ The way in which the foveal curve is drawn in Figs. 1 and 2 has been guided in detail by these earlier observations.

The present measurements depart widely at low wave-lengths, however, from the photopic luminosity function standardized by the International Commission on Illumination at Geneva in 1924 (the I.C.I. function). At 436 m μ they reveal an average sensitivity about 2.4 times, and at 405 m μ about 9 times as high as the I.C.I. factors indicate. This disagreement with the standardized function does not extend to some of the most careful measurements on which it was based, those of Coblentz and Emerson,⁶ and of Gibson and Tyndall,⁷ which between 450 m μ and 427 m μ —below which they do not penetrate—depart from the I.C.I. curve much as do my own.⁸ The I.C.I. function in the blue and violet represents a compromise between the measurements of Nutting⁹ and of Hartman,¹⁰ which disagree widely with each other. Nutting's data diverge from the standardized function below 430 m μ , to come close at 400 m μ to my own; while Hartman's data go off in the opposite direction.

PERIPHERAL RODS

When the image of the test field falls 8° above the fovea in the dark-adapted eye, the response at the threshold is due entirely to rods. As one indication of this, the field is seen as colorless at all wave-lengths.

Such measurements of the spectral sensitivity of peripheral rods are shown in Fig. 1 and Table 1. They are averages from the same 22 observers who yielded the foveal function. The sensitivities are here expressed relative to the foveal maximum. Fig. 3 shows similar data from 52 subjects of average age 21; these are plotted relative to their own maximum.

⁴ Reviewed by K. Gross, *Z. Sinnesphysiol.*, 59: 215, 1928.

⁵ Reviewed by K. S. Gibson, *Jour. Opt. Soc. Amer.*, 30: 51, 1940.

⁶ W. W. Coblentz and W. B. Emerson, *Bull. Nat. Bur. Stand.*, 14: 167, 1918-19.

⁷ K. S. Gibson and E. P. T. Tyndall, *Sci. Pap. Nat. Bur. Stand.*, 19: 131, 1923-24.

⁸ See also W. S. Stiles, *Nature*, 154: 290, 1944.

⁹ P. G. Nutting, *Phil. Mag.*, London, 29: 301, 1915; revised data in *Jour. Opt. Soc. Amer.*, 4: 55, 1920.

¹⁰ L. W. Hartman, *Astrophys. Jour.*, 47: 83, 1918.

These observations differ only in detail from earlier measurements made in more restricted ranges of wave-length, either by a comparable procedure,¹¹ or by brightness-matching in large central retinal areas at low illuminations.¹²

The rod sensitivity is maximal at about 505 m μ . At 365 m μ it has fallen on the average to about 1/20,000, and at 750 m μ to about 1/2,500,000 of the maximum value. Below 550 m μ the dark-adapted periphery is 100 to more than 1,000 times as sensitive as the fovea (Fig. 1). Above this wave-length the peripheral and foveal functions draw together, and at

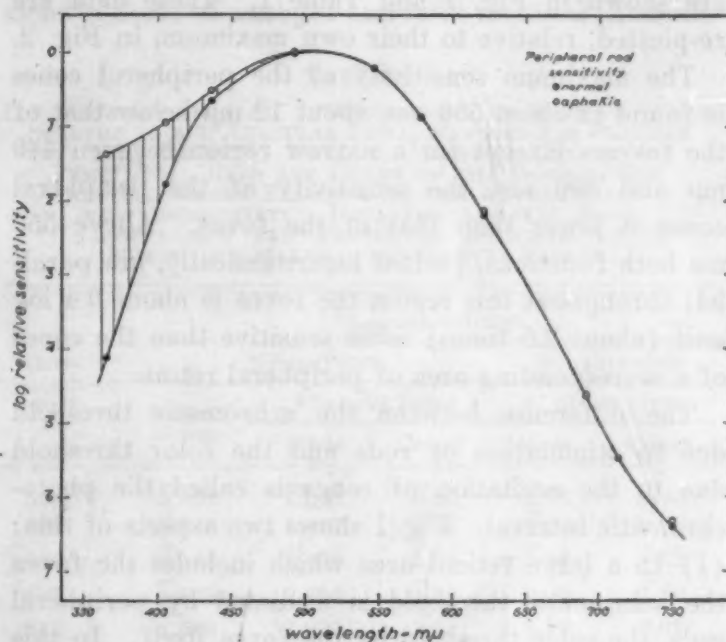


FIG. 3. Spectral sensitivities of rod vision in an area 8° above the fovea in the normal and aphakic eye. Both functions have been brought together above 546 m μ , where they are parallel. The vertically hatched area represents the optical density of the lens.

about 650 m μ they cross. In the farther red the fovea is more sensitive than the periphery. These relations change somewhat in test fields of other sizes and other durations of exposure than were used in the present experiments.

PERIPHERAL CONES

The following procedure was devised for measuring the spectral sensitivity of cones in peripheral areas of the retina. If the eye is highly light-adapted and then placed in darkness, the threshold for a time is due to cones. During this interval the stimulus looks colored at all wave-lengths. The threshold falls rapidly to a plateau, held constant from about the fourth to the eighth minute or longer. This is the threshold level of the completely dark-adapted cones;

¹¹ W. deW. Abney and W. Watson, *Phil. Trans. Roy. Soc. London*, A216: 91, 1915.

¹² S. Hecht and R. E. Williams, *Jour. Gen. Physiol.*, 5: 1, 1922-23; K. S. Weaver, *Jour. Opt. Soc. Amer.*, 27: 36, 1937.

it is maintained long enough to permit its measurement with some precision. Later, the dark-adaptation of the rods supervenes; the threshold falls again to a new and final level. By repeatedly light-adapting the eye and measuring the cone plateaux at various wavelengths, one can determine the spectral sensitivity of dark-adapted cones in any desired area of retina.

Such measurements have been performed with 10 of the 22 subjects who yielded the data previously described. The same retinal area was employed as in the rod measurements. The averaged sensitivities of the peripheral cones, relative to the foveal maximum, are shown in Fig. 1 and Table 1. These data are re-plotted, relative to their own maximum, in Fig. 2.

The maximum sensitivity of the peripheral cones is found at about 550 m μ , about 12 m μ below that of the fovea. Except for a narrow region between 440 m μ and 490 m μ , the sensitivity of the peripheral cones is lower than that of the fovea. Above 550 m μ both functions, plotted logarithmically, are parallel; throughout this region the fovea is about 0.4 log unit (about 2.5 times) more sensitive than the cones of a corresponding area of peripheral retina.

The difference between the achromatic threshold due to stimulation of rods and the color threshold due to the excitation of cones is called the photochromatic interval. Fig. 1 shows two aspects of this: (1) In a large retinal area which includes the fovea the achromatic threshold is mediated by peripheral rods, the color threshold by the fovea itself. In this instance the photochromatic interval decreases sharply in the yellow and orange, and ceases to exist above 650 m μ . (2) In a fixed peripheral area, the interval between rod and cone thresholds is larger, and continues throughout the spectrum. Even in the far red, a peripheral stimulus is seen at the threshold as colorless, and its intensity must be raised about 0.2 log unit for color to appear.

When the sensitivity functions of foveal and peripheral cones are plotted to the same maximal value, as in Fig. 2, they are seen to be very different in shape. The foveal cones are relatively less sensitive than those of the periphery between about 380 m μ and 550 m μ . The difference, shown in the figure as a horizontally hatched area, is due to the absorption of light in the fovea by the macular pigmentation.

THE MACULAR PIGMENT

The macular pigmentation lowers the relative sensitivity of the central retina at various wave-lengths by a factor equivalent to the fraction of incident light which it transmits. The macular transmission is obtained directly by dividing the foveal by the peripheral cone sensitivity. Consequently the difference between the logarithms of the peripheral and

foveal sensitivities—the horizontally hatched area of Fig. 2—represents directly $\log 1/\text{transmission}$, or the optical density, of the macular pigment. This is plotted in Fig. 4 (open circles). It rises steeply from about 550 m μ to a broad maximum in the region 430–490 m μ , then falls to negligible values in the near ultra-violet. Earlier estimates of macular absorption have involved only the long-wave-length limb of this function;¹³ in this restricted region they agree approximately with the present data.

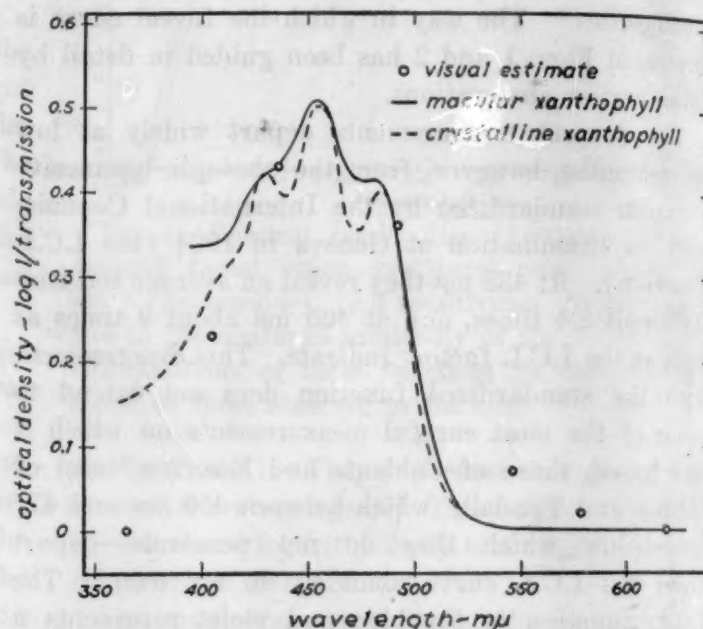


FIG. 4. The absorption spectrum of the macular pigment. The open circles are visual estimates of this, differences in log sensitivity of peripheral and foveal cones, taken from Fig. 2. The solid line is the absorption spectrum of a partially purified preparation of xanthophyll extracted from human maculas. The broken line is the spectrum of a preparation of crystalline leaf xanthophyll.

In our 10 subjects the macular pigment absorbs on the average about 60 per cent. of light of wave-length 430–490 m μ incident on the fovea. This pigment is responsible for the deep inflection in the foveal sensitivity function in the neighborhood of 450–470 m μ . The depth of pigmentation, however, varies greatly in our observers. In one of them no pigmentation was perceptible; in another the pigment absorbed more than 90 per cent. of light incident at 436 m μ . These wide variations probably account for marked disagreements in the anatomical literature regarding the occurrence and depth of pigmentation in the fovea.¹⁴ It is clear from our data that some foveas are virtually unpigmented, while others are intensely colored. In the latter instance, the pigment must affect profoundly the contributions of blue and violet light to the color sensations of the

¹³ M. Sachs, *Arch. ges. Physiol.*, 50: 574, 1891; A. Kohlrausch, *Ber. ges. Physiol.*, 22: 495, 1923; S. W. Kravkov, *Arch. ges. Physiol.*, 210: 781, 1925.

¹⁴ S. L. Polyak, "The Retina," Chicago, 1941, p. 222.

fovea; this matter will be discussed at some later opportunity.

The shape of the macular absorption spectrum as estimated visually suggests that the pigment is a carotenoid. This class of yellow, fat-soluble substances typically possesses absorption spectra which rise from about 550 m μ to a broad, complicated maximum in the blue and violet, then fall again at lower wave-lengths.

To explore this possibility I have extracted a small number of human maculas. They yield to benzene or chloroform a yellow pigment which has proved to be a hydroxy-carotenoid or xanthophyll, in all probability lutein or leaf xanthophyll itself (C₄₀H₅₄(OH)₂). This marks the first appearance of a carotenoid of this type in a mammalian retina.

The absorption spectrum of a crude preparation of macular xanthophyll is shown in Fig. 4. It has been brought to the height indicated by the visually estimated absorption. The spectrum of crystalline leaf xanthophyll is also shown in the figure. It differs no more from the spectrum of the macular pigment than is to be expected in a comparison of a crude tissue extract with the pure substance.

Extra-macular portions of the human retina also contain some xanthophyll, but only about 1/15-1/20 as much per unit area of retina as the maculas. This general pigmentation probably accounts for the small inflection in the region of 470 m μ in the spectral sensitivity function of peripheral cones.

APHAKIC VISION, ROD AND CONE

Measurements of spectral sensitivity, rod and cone, centrally and peripherally, have been performed in subjects whose lenses had been removed in the operation for cataract. With the loss of the yellow lens the eye gains enormously in sensitivity in the violet and ultra-violet.

Measurements on aphakic subjects are shown in Figs. 2 and 3, and in the last two columns of Table 1. In the figures the aphakic data have arbitrarily been brought together with normal results above 550 m μ , where all the functions are parallel. The data on aphakic rod sensitivities include measurements on 39 eyes of 24 subjects; those on aphakic cones are from 6 subjects.

The spectral sensitivity curves of the aphakic eye decline much less steeply at low wave-lengths than the normal functions. At 365 m μ , aphakic rod or cone vision is still about 1/30 as sensitive as at the maximum. At this wave-length the aphakic rods are as sensitive as in yellow light, the cones as sensitive as in the near red. The average sensitivity of the aphakic eye at 365 m μ is about 1,000 times that of normal observers.

It has long been known that certain insects are highly sensitive to ultra-violet light, and it has been alleged that they respond to it with a special quality of color sensation.¹⁵ There has also been some discussion in the past of the unique visual experiences which may accompany such properties.

This need no longer be a matter of pure speculation, for aphakic persons see very well in the ultra-violet. That this ordinarily produces no striking distortion of their visual experiences may be judged from the fact that they usually are wholly unaware of their extraordinary capacities. The relatively low ultra-violet content of sunlight and most artificial illumina-

TABLE 1
LOG SENSITIVITY (LOG 1/THRESHOLD) AT VARIOUS WAVE-LENGTHS IN A 1° CIRCULAR FIELD, EXPOSED FOR FLASHES OF 1/25 SECOND. DATA FOR FOVEAL CONES, AND PERIPHERAL RODS AND CONES OF THE NORMAL EYE ARE EXPRESSED RELATIVE TO THE FOVEAL MAXIMUM SENSITIVITY. DATA FOR APHAKIC RODS AND CONES ARE PRESENTED RELATIVE TO THEIR OWN MAXIMAL SENSITIVITY VALUES

| Wave-length (m μ) | Log sensitivity | | | | |
|------------------------|-----------------|----------------|-------|-----------------|-------|
| | Normal eyes | | | Aphakic eyes | |
| | Foveal cones | 8° above fovea | | 8° above fovea | |
| | | Rods | Cones | Rods | Cones |
| 365 | 5.401 | 2.042 | 6.95 | 2.62 | 2.42 |
| 405 | 3.806 | 0.427 | 3.64 | 1.05 | 2.88 |
| 436 | 2.643 | 1.675 | 2.67 | 1.48 | 1.22 |
| 492 | 1.288 | 2.295 | 1.25 | 0.00 | 1.80 |
| 546 | 1.980 | 2.095 | 1.65 | 1.78 | 0.01 |
| 578 | 1.966 | 1.375 | 1.59 | 1.12 | 1.90 |
| 621 | 1.626 | 0.038 | 1.27 | 3.87 | 1.63 |
| 691 | 3.840 | 3.635 | 3.43 | 5.39 | 3.87 |
| 713 | 3.048 | 4.787 | 4.59 | 6.52 | 3.11 |
| 750 | 4.072 | 5.890 | 5.68 | 7.68 | 4.18 |
| Number of subjects | 22 | 22 | 10 | 24 (39 eyes) | 6 |

tions is of course partly responsible for this. Nor does the hypersensitivity of aphakics in the ultra-violet bring them new sensations; they seem to see this region as they do 405 m μ , as blue or violet.

When the illumination is confined to the region of 365 m μ , nevertheless, the vision of aphakics is sufficiently remarkable. In this radiation I have frequently had 60- to 70-year-old aphakics read a Snellen chart from top to bottom, under circumstances in which I was unable to see the chart.

The high sensitivity of the aphakic eye to the ultra-violet has only recently been described, as the result of a chance observation by Gaydon, who suffered the loss of one eye and the lens of the other in a laboratory accident.¹⁶ The sensitivity of Gaydon's periph-

¹⁵ L. M. Bertholf, *Jour. Agr. Res.*, 43: 703, 1931; *Z. vergl. Physiol.*, 18: 32, 1932-33; A. Kühn, *Z. vergl. Physiol.*, 5: 762, 1927.

¹⁶ A. G. Gaydon, *Proc. Phys. Soc.*, 50: 714, 1938.

eral rods was later measured at 365 and 546 m μ , and found to be nearly equal at these wave-lengths. On comparison of this result with other types of data, it was concluded that the aphakic rod sensitivity passes through a minimum at about 400 m μ , to rise again at lower wave-lengths.¹⁷ The present measurements show no indication of such changes.

THE LENS

The differences in log sensitivity of normal and aphakic eyes, shown as vertically hatched areas in Figs. 2 and 3, represent directly the optical density of the human lens. These values are for subjects averaging 20 years of age. It is well known that in older persons the lens is more deeply pigmented.

The rod and cone estimates of lens absorption agree reasonably well with each other. The rod data involve many more subjects and are the more reliable. They show that the density of lens absorption rises rapidly and regularly from about 500 m μ into the ultra-violet. At 405 m μ the average lens transmits about 15 per cent., at 365 m μ about 0.1 per cent. of the radiation incident upon it.

The pigmentation of the lens varies greatly in different individuals even within a narrow age-group. In our normal subjects this factor alone adds more than a logarithmic unit to the variation in sensitivity at 365 m μ .

We have measured the absorption spectra of a number of isolated lenses from persons 63-68 years of age. As expected, these involve much higher optical

densities than we have estimated visually in young subjects. They do, however, exhibit the same general character of absorption, the density rising without inflection into the ultra-violet.

CONCLUSION

Measurements made in the periphery of the aphakic eye come as close to the intrinsic sensitivities of rods and cones as it is possible to approach *in vivo*. The lens has been removed, the macular pigmentation avoided. Only the minor pigmentations of the cornea, ocular humors and extramacular retina remain to screen the receptors. This is as far as the analysis of spectral sensitivity in the functioning eye can penetrate.

The sensitivities of the rods and cones are related intimately to the absorption spectra of their photosensitive pigments, rhodopsin and iodopsin.¹⁸ The spectrum of rhodopsin is known with some assurance. The over-all transmission of the human eye has also been measured.¹⁹ With these data one can compute a spectral sensitivity function for normal rod vision which agrees well with that observed.²⁰ We still lack adequate information concerning the absorption spectrum of iodopsin, and of some of the separate ocular structures through which light passes before striking the receptor cells. When these have become available we shall be in position to synthesize from their basic components the spectral sensitivity functions of rod and cone vision, centrally and peripherally, and in the normal and aphakic eye.

OBITUARY

LEWIS RALPH JONES 1864-1945

LEWIS RALPH JONES, professor emeritus of plant pathology of the University of Wisconsin, died at Orlando, Florida, on April 1, 1945, in his eighty-first year. In his passing biological science loses one of its foremost leaders.

He was born on a farm near Brandon, Wisconsin, on December 5, 1864, the third of six children of David and Lucy Knapp Jones, leaders in the settlement and early development of that community. His early education was at Brandon, followed by three years at Ripon College. For advanced studies he went to the University of Michigan, from which he received the Ph.B. degree in 1889 and the Ph.D. in 1904. At Michigan he gained much from the influence of such great men as President Angell, Professors Spalding, Vaughan and Novy, and Erwin F. Smith, then an exceptionally brilliant and mature

graduate student who was later to become an outstanding leader in plant pathology and experimental biology.

In 1887 and 1888 he taught natural science for a year and a half at the Mt. Morris Academy, Mt. Morris, Illinois. The success of this early teaching is attested by the life-long friendship and devotion of members of his classes.

In 1889 he was called to the University of Vermont, where, after a brief period as instructor in natural history, he served as assistant professor of natural history, 1891-92, associate professor of natural history, 1892-93, professor of botany, 1893-1910, and botanist of the Vermont Agricultural Experiment Station, 1889-1910.

On June 24, 1890, he married May I. Bennett, who

¹⁸ G. Wald, *Nature*, 140: 545, 1937.

¹⁹ E. Ludvigh and E. F. McCarthy, *Arch. Ophth.*, 20: 37, 1938.

²⁰ G. Wald, *Jour. Gen. Physiol.*, 21: 795, 1937-38; E. Ludvigh, *Arch. Ophth.*, 20: 713, 1938; S. Hecht, S. Shlaer and M. H. Pirenne, *Jour. Gen. Physiol.*, 25: 819, 1941-42.

¹⁷ C. F. Goodeve, R. J. Lythgoe and E. E. Schneider, *Proc. Roy. Soc. London*, B130: 380, 1942.

young
gen-
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d on September 22, 1926. On July 27, 1929, he married Anna M. Clark, who survives him.

His twenty years of service at the University of Vermont, interspersed with travel and special studies at the University of Michigan, in the U. S. Department of Agriculture and in Europe, marked the first phase of Professor Jones' career and established him as a leader in American botany and plant pathology. As professor of botany, he became one of the most effective and beloved teachers of the University of Vermont. As botanist of the Agricultural Experiment Station, he was highly productive in research in its practical applications, developing a national leadership in studies of the nature and control of plant diseases. Especially noteworthy contributions during this period were his pioneering in the use of Boron mixture in America, his classical studies of the late blight of potato and his exact researches on the nature and cause of bacterial soft rot of vegetables.

His influence, however, extended far beyond the boundaries of his special field. He was a trusted counselor, both of students and colleagues, and a guiding spirit in the life of the university. He was highly instrumental in establishing the teacher-training work of the university and, in addition to his other duties, served as the first dean of the department of teaching. He was the leading organizer of the Vermont Botanical Club and an organizer and president of the Vermont Forestry Association. The R. Jones State Forest of Vermont was named in recognition of his services to forestry.

In 1909 Professor Jones was called to the University of Wisconsin to found its department of plant pathology. To this task he brought the rare talents and devotion that were to win him recognition, not only as dean of the plant pathologists of his generation, but also as one of the foremost leaders of his time in the broad field of biology and agriculture.

He combined the highest ideals of scholarship with first-hand understanding of the practical needs of agriculture and a vital interest in the applications of science to the service of mankind. He had the vision and the ability to integrate his new department closely with the supporting departments of the university and with the U. S. Department of Agriculture, always fostering mutual assistance and cooperation.

He was rarely gifted in understanding and inspiring both his students and his colleagues and gave of himself without reservation. Students came to his laboratory from all over the world, and have gone forth to most of the states of our Union and to many foreign lands with the benefits of his training and the stamp of his character.

Professor Jones conceived of research as the central activity about which to build his department.

Only by competent research on the basic problems of plant disease development and control could the practical needs of agriculture be met. Only upon the results of such research could adequate instruction be based. He knew that students learn best by doing, and early recognized the great advantages of closely integrating postgraduate teaching with the research program of the department. Though the time he could devote to his individual researches was progressively limited by the multiplicity and weight of his responsibilities, the quality of his work set a standard for all. His contribution as director of the research work of his department and as leader and counselor in the development of trends of research in plant pathology was of the highest importance. Notable examples, both of his personal research and his leadership in trends of research, are found in his contributions to the study and development of disease-resistant varieties of plants and his work on the influence of environment on the expression of plant diseases. His published scientific works include over two hundred titles.

The development of his department was but one of Professor Jones' great contributions. His knowledge and experience, breadth of vision, wisdom and rare constructive abilities were constantly in demand.

He contributed generously to the broader aspects of the development of the University of Wisconsin. He was one of the founders and the first president of the American Phytopathological Society and the first editor of its journal, *Phytopathology*. He served as president of the Botanical Society of America and as editor of the *American Journal of Botany*. He was a leader in many scientific movements and the recipient of many honors at home and abroad. He was a member of the National Academy of Sciences, the American Philosophical Society, the Academy of Natural Sciences of Philadelphia and many other scientific organizations, including honorary membership in the four leading societies of his profession in foreign countries. He was an organizer and trustee of the Boyce Thompson Institute for Plant Research and an organizer and a chairman of the executive committee of the Tropical Plant Research Foundation. He was an early chairman of the Division of Biology and Agriculture of the National Research Council and a member of the Science Advisory Board appointed by President Roosevelt. He served as chairman of the Section of Mycology and Plant Pathology of the Fifth International Botanical Congress and as honorary chairman of the Third International Congress for Microbiology. The honorary degree of doctor of science was conferred upon him by the University of Vermont in 1910, the University of Cambridge in 1930 and the University of

Wisconsin in 1936. He was awarded the honorary degree of doctor of laws by the University of Michigan in 1935.

The pressures of Professor Jones' scientific responsibilities were not allowed to mar the graciousness of his life. He was the kindest and most considerate of men, ever available to his students and his colleagues for wise and sympathetic counsel. His students were always welcome in his home, and many of their happiest memories center about his hospitable fireside. Ever keenly interested and active in the cultural, civic and religious life of his community, he was a member of the University Heights Poetry Club, the Madison Literary Club, the University Club, the Rotary Club and the Congregational Church.

Though he retired from active service in 1935, Professor Jones continued to carry important responsibilities as committee man, trustee and counselor. The leisure of his later years permitted much of the travel that he and Mrs. Jones so much enjoyed. Always central in their travel plans was the continuation of his long-established custom of visiting colleagues and former students, ever radiating encouragement, inspiration and good cheer.

Professor Jones was an epic figure in an epic period in the development of American science. When he began his work at Vermont, the science of plant pathology was still in its infancy. He was quick to see the great needs that lay ahead and able to contribute a unique leadership in the molding of this new science. At the end of the first world war, when major responsibilities for scientific leadership shifted from Europe to America, his school of plant pathology at Wisconsin was fully established and he was ready and able to contribute largely to leadership in the broad field of biology and agriculture.

Distinguished as were Professor Jones' contributions to science, the true measure of his greatness was as a man. What he did was possible only because of what he was. The nobility of his character and

his unselfish devotion to the service of others were lasting inspiration to those who had associations with him. The highest tribute that can be paid him is love and honor in which he is so universally held by those who knew him.

G. W. KEITH

RECENT DEATHS

DR. PETER I. WOLD, chairman of the department of physics of Union College, Schenectady, N. Y., died on June 17 at the age of sixty-three years.

DR. FLORENCE BASCOM, who retired in 1928 with the title emeritus from the professorship of geology at Bryn Mawr College, died on June 19 at the age of eighty-two years.

DR. LEON H. LEONIAN, professor of mycology and mycologist in the Agricultural Experiment Station of West Virginia University, died on June 7 at the age of fifty-seven years. A student loan fund in memory has been established by his friends and colleagues at West Virginia University.

RICHARD S. McCAFFERY, mining engineer, from 1914 to 1941 professor of mining and metallurgy at the University of Wisconsin, died on June 12 at the age of seventy-one years.

DR. BEVERLEY RANDOLPH TUCKER, physician in charge of the Tucker Sanitarium at Richmond, Va. since 1938 emeritus professor of neurology and psychiatry of the Medical College of Virginia, died on June 10 at the age of seventy-one years.

G. C. ROBSON, deputy keeper in the department of zoology of the British Museum (Natural History) South Kensington, died on May 17.

THE death on May 24 at the age of seventy-five years is announced of Sir Martin Forster, F.R.S. from 1922 to 1933 research chemist and director of the Indian Institute of Science at Bangalore.

SCIENTIFIC EVENTS

THE GREAT LAKES RESEARCH INSTITUTE

THE establishment of the Great Lakes Research Institute, a scientific group to study the chemical, physical and biological aspects of the Great Lakes and their shorelines, has been authorized by the Board of Regents of the University of Michigan. It will be placed under the Rackham School of Graduate Studies, but will be governed by a Board of University Studies, of twelve members, each a specialist in a different physical or biological field. The work of the institute will be, in general, parallel to that being done on the

Atlantic seaboard by the Woods Hole Oceanographic Institution and on the West coast by the Scripps Institution of Oceanography. It will concern itself with such topics as submarine topography, plant and animal life, water pollution, chemical composition of water, difference in water levels, currents, tides, temperatures, flows of water and winds.

Outside investigators and other academic groups having an interest in research on the Great Lakes will be invited to cooperate. Since relatively little research has been done, opportunities for investigation are

ly unlimited. It is planned to initiate long-term research programs that will extend over a period of years.

Plans for the organization of the institute have been under discussion for nearly two years by a special committee of the faculty. Members of the governing board will have terms of six years, with the initial appointments staggered.

The following professors, all of whom were members of the organizing committee, have been named by the regents of the university members of the governing body: P. S. Welch, limnology; F. K. Sparrow, botany; L. A. Baier, naval architecture and marine engineering; Earnest Boyce, sanitary engineering; L. Belknap, meteorology; Dean S. T. Dana, forestry; E. F. Greenman, anthropology; K. K. Landes, zoology; H. B. Lewis, biological chemistry; K. C. Murry, geography; H. van der Schalie, zoology, and James Wilson, geophysics.

At a meeting of the council on June 2, Professor P. S. Welch, the limnologist, was elected chairman, and F. K. Sparrow, botanist, secretary.

THE LABORATORY OF INDUSTRIAL ELECTRONICS AT SYRACUSE UNIVERSITY

The establishment of the new Laboratory of Industrial Electronics in the Department of Electrical Engineering at Syracuse University will give emphasis to the application of electronic tubes and related circuits in the field of industrial control and measurements.

The need of such training was recognized well before the beginning of the war, in engineering colleges and vocational schools. But war production requirements so extended this field that now it has become imperative for postwar planning to make the educational facilities in applied electronics as available in industrial applications as in the field of communication.

The May, 1945, issue of *Electronics* carries a summary of "Electronic Application in Industry," the result of a wide survey in eleven leading industries, conducted by the Research Department of the McGraw-Hill Publishing Company, Inc.

Courses of study are arranged with two objectives in mind: (1) At the graduate level, where advanced training in the mathematical and physical performance of control and measurement circuits will be required. (2) At the undergraduate level, where a basic understanding of electronic tubes, circuits, etc., will be related to problems in application engineering appearing in industrial processes.

Besides adequate space, power, arrangement and measuring equipment, the laboratory contains:

- (1) X-ray equipment (15 kV) for inspection of welds—castings, etc.

- (2) High frequency heating applied to (a) metals in brazing, soldering, welding, etc.; (b) plastics in preheating and molding.
- (3) Power conversion: rectifiers, inverters, amplifiers, mototrols, thymatrols, etc.
- (4) Electronic measurements: strain gage, stroboscopic, vibration, stability, etc.
- (5) Electrostatic precipitation—dust control.
- (6) Resistance welding control: providing studies in time and heat control.

It is hoped that this new laboratory will prove a center of stimulating interest and that the student will gain thereby a more thorough-going appreciation of the basic features that go together to produce an engineering achievement.

THE VIRGINIA SECTION OF THE AMERICAN CHEMICAL SOCIETY

DR. WILLIAM R. HARLAN, assistant director of research for the American Tobacco Company, was elected chairman of the Virginia Section of the American Chemical Society at the June meeting, which was held at the Country Club of Virginia. The speaker of the evening was J. Bernard Robb, the author of "Welcome Hinges." Dr. Robert H. Kean, retiring chairman of the section, presided at the dinner meeting, the arrangements for which were made by Dr. Miriam F. Clarke and Miss Louise Hutzler, of the department of chemistry of the Medical College of Virginia.

Other officers elected were Clifford M. Smith, research chemist, rayon technical division, E. I. du Pont de Nemours and Company, Waynesboro, *Executive Vice-chairman*; Robert L. Riggs, superintendent of the end products subdivision, Solvay Process Company, Hopewell, *Vice-chairman*; Dr. Mary E. Kapp, research chemist, rayon division, E. I. du Pont de Nemours and Company, Richmond, *Secretary*, and Dr. James J. Carney, factory department head, Merck and Company, Inc., Elkton, *Treasurer*. Councilors elected for the ensuing year were Dr. James W. Cole, assistant professor of chemistry, University of Virginia; Dr. J. C. Forbes, research professor of biochemistry, Medical College of Virginia; Dr. William E. Trout, Jr., professor of chemistry, Mary Baldwin College, Staunton, and Dr. I. A. Updike, professor of chemistry, Randolph-Macon College, Ashland. Dr. William A. Peabody, vice-president and chemical director of Valentine Meat-Juice Company, Richmond, was elected to the publications board; Rodney C. Berry, chief chemist for the State Department of Agriculture, and Dr. John H. Yoe, professor of chemistry at the University of Virginia, were named members of the board of trustees. Members of the nominating committee were Dr. James W. Cole, Dr. R. F. Conway, H. R. Hanmer, Dr. W. F. Rudd and Dr. Sidney S. Negus, *chairman*.

GRANTS OF THE NATIONAL ADVISORY CANCER COUNCIL

NINE grants-in-aid amounting to \$79,377 were approved at the twenty-eighth meeting of the National Advisory Cancer Council held at the National Cancer Institute of the U. S. Public Health Service, Bethesda, Maryland.

These funds, the greatest amount ever granted at one time by the council, reflect the growing interest in the disease by medical groups throughout the country who are joining hands in cancer research and education. At the present time cancer is the second cause of death in the nation.

The largest individual grant, \$24,500, was made to Harvard University, Boston, for the study of the relation of steroid hormones to growth and tumors. Dr. J. H. Means will be in charge of this work. Drs. Fuller Albright and Joseph C. Aub will also participate in these studies.

Mt. Sinai Hospital, New York, was next on the list of approved grantees with a request of \$10,775 for clinical studies on gastric cancer. This work will be under the direction of Dr. Franklin Hollander.

Harvard University was given an additional grant of \$10,000 for study of the pathology of cancer of the stomach, peptic ulcer and gastritis, with Dr. Shields Warren in charge.

Another grant was voted for clinical studies of gastric cancer which will be conducted by Dr. Leon Schiff, of the University of Cincinnati. The school was granted \$10,000 for this purpose.

Approval was also given to the request for \$8,500 for research in cancer education of Northwestern University. Dr. A. C. Ivy, member of the council, will supervise the work.

Dr. Paul A. Zahl will direct research on the virus-like agent in mammary cancer of mice for which the Haskins Laboratories, New York City, was granted \$5,000.

The relation of certain types of diets to induced cancer in rats is the research planned by the Detroit Institute of Cancer Research, Detroit. A grant of \$6,152 was recommended for the study. Dr. W. F. Dunning will be in charge.

New York University, New York, was granted \$3,500, which will be used by Dr. Robert W. Chambers in a study of Hodgkins disease.

A grant of \$1,450 was made to the University of Minnesota, Minneapolis, where studies on leukemia in mice will be conducted by Dr. Arthur Kirschbaum.

Members of the council are Dr. George M. Smith, executive director, professor of anatomy of Yale University; Dr. Frank E. Adair, president of the American Cancer Society, Inc., and a staff member of Memorial Hospital for the Treatment of Cancer and Allied Diseases, New York City; Dr. A. C. Ivy, pro-

fessor of physiology of the Medical School of Northwestern University; Dr. James B. Murphy, Rockefeller Institute for Medical Research, New York; A. Baird Hastings, Harvard University Medical School, Boston, and Dr. Sherwood Moore, director of the Mallinckrodt Institute of Radiology, St. Louis. Surgeon General Parran is chairman, *ex officio*, of the council.

The Public Health Service was represented by R. E. Dyer, director of the National Institute of Health; Dr. R. R. Spencer, director of the National Cancer Institute, and Dr. Ralph Braund, director of the Tumor Clinic of the U. S. Marine Hospital, Baltimore.

NEWS OF FRENCH SCIENTIFIC MEN

SCIENCE has received from Professor W. R. Taylor of the University of Michigan, news in regard to scientific men in France that, with the exception of the announcement of the death of M. Allorge, has not been recorded in the journal. The communications received by him from correspondents read follows:

... I beg to give you some news—unfortunately news—from the Laboratoire de Cryptogamie. I am very grieved in informing you of M. P. Allorge's death, which occurred January 21, 1944, consecutive to a painful illness. Abbé Frémy, a victim of the St. Lô bombardment (Manche), August 6, died on August 14. My old friend and colleague, G. Hamel, was wounded to death on the road, on August 18, 1944. You may realize how French algology has been touched during 1944. At the beginning of the war I had the herbaria Bornet and Thuret transported to Bretagne. The collections are quite safe and have been conveyed again to Paris. M. Heim, who will succeed Professor Allorge as director of the Laboratoire de Cryptogamie, has been taken into custody and is still in Germany. We are going to issue a small addition to *Revue Algologique* in order to complete Vol. XII. During the invasion in 1942, we succeeded in issuing Vol. XIII named *Travaux Algologiques*.

This was signed by Rob. Lami, assistant at the Laboratoire de Cryptogamie, and was dated from Paris March 21, 1945.

... I am very sorry to tell you to-day that M. Emile Chemin died on April 4 following a painful illness. In addition, Professor R. Guillermond, a specialist in plant cytology, died recently in Lyon after a long illness.

This also was signed by Rob. Lami, and was dated from Paris April 17, 1945.

Professor Allorge was director of the Laboratoire de Cryptogamie of the National Museum of Natural History, Paris. Gotran Hamel was a specialist there on marine algae and the Abbé Frémy a specialist on

Myxophyceae. Professor Guilliermond was a student of the structural elements of the cytoplasm. Professor Chemin studied the physiology of algae.

... In spite of many dangers during the past five years I am safe and my family too. My laboratory was only slightly damaged and the work of the University is now going on about as usual. This summer I hope to be able to stay for some months again in my former University of Montreal. . . .

This was dated April 10, 1945, and was signed by

Professor Henri Prat, of the Faculté des Sciences de Marseille.

... et j'ai le plaisir de vous informer que nos laboratoires et nos collections n'ont pas jusqu'ici souffert de la guerre. . . .

This was dated April 12 and was signed by Professor P. Dangeard, of the Université de Bordeaux.

We also learn from Professor Georges Bioret (Angers) that he and his collections are safe; he confirms the loss of Frémy.

SCIENTIFIC NOTES AND NEWS

IN tribute to his leadership in advancing industrial science, the degree of doctor of science was conferred on Dr. Clyde E. Williams, director of Battelle Memorial Institute, Columbus, Ohio, at the recent convocation ceremonies of the Case School of Applied Science.

KALAMAZOO COLLEGE has conferred the doctorate of science on Dr. Harold W. Brown, professor of parasitology at the College of Physicians and Surgeons, Columbia University, and the degree of humane letters on Dr. Martha J. Gifford, until recently a member of the staff of the Ellen Mitchell-Memorial Hospital, Moulmein, Burma.

THE honorary degree of doctor of science has been conferred by Grinnell College on Dr. Ernest E. Charlton, in charge of the X-ray Section of the General Electric Research Laboratory, Schenectady. Dr. Charlton was graduated from the college in 1913.

COLONEL HAROLD B. GOTAAS, Sn.C., director of the Division of Health and Sanitation of the Institute of Inter-American Affairs, has been decorated by the Chilean Government with the Order of Merit. Before joining the Army in 1942, Colonel Gotaas was professor of sanitary engineering in the School of Public Health of the University of North Carolina.

THE British Council of the Institute of Fuel has awarded the Melchett Medal for 1945 to Professor C. H. Lander, professor of mechanical engineering at the Imperial College, London.

THE freedom of the borough of Paddington has been conferred on Sir Alexander Fleming, F.R.S., as a token of the high esteem in which he is held by the civic authority of the borough, where he has carried out his scientific researches at St. Mary's Hospital, in which his discovery of penicillin was made.

DR. GEORGE A. VAN BIESBROECK, professor of astronomy at the University of Chicago, will retire with the title emeritus on July 1.

THE retirement is announced of Professor Mortier F. Barrus, professor of plant pathology at Cornell

University. He has been a member of the department for thirty-five years.

PROFESSOR CHARLES F. THOMAS, of the department of mathematics of the Case School of Applied Science, has retired after serving for thirty-nine years.

PROFESSOR CHARLES J. MOORE, for twenty-four years chairman of the department of chemistry of Hunter College, will retire in September.

DR. JOSEPH S. FRUTON, associate in chemistry at the Rockefeller Institute for Medical Research, has been appointed associate professor of physiological chemistry at Yale University, the appointment to take effect on July 1.

MAJOR KARL M. DALLENBACH, of the U. S. Army, on leave from the professorship of psychology at Cornell University, will become Susan Linn Sage professor of psychology on his return from military service. This professorship was established in 1885 as a gift from Henry W. Sage.

AT the University of Minnesota Professor Lorenz G. Straub, now on leave, has been promoted to be head of the department of civil engineering of the College of Engineering, to succeed Professor Frederic Bass, who retired two years ago. Robert H. Cameron, of the Massachusetts Institute of Technology, has been made professor of mathematics. Dr. Herbert S. Wells, of the University of Tennessee, has been appointed professor of biophysics for work in physical medicine, for which the university recently announced a considerable grant.

DR. L. T. MORDELL, since 1923 Fielden professor of pure mathematics at the University of Manchester, has been appointed to succeed Professor G. H. Hardy in the Sadleirian chair of pure mathematics at the University of Cambridge.

DR. G. H. A. CLOWES, who has occupied the position of director of the Lilly Research Laboratories for more than twenty years, will retire on July 1. In the ordinary course of events Dr. Clowes would have retired on January 1, 1943, but on account of the war

emergency he has continued to direct research on various war problems. As research director emeritus, he will still act in an advisory capacity and continue to direct research on certain fundamental problems in which he is particularly interested in Indianapolis and Woods Hole. The Lilly Company has no immediate intention of appointing a research director in his place. The present heads of departments will retain their positions and some new departments may be created. A vice-president of the company will take charge of general administration, so as to leave the heads of individual research units free to devote their entire attention to research.

THE retirement on July 1 is announced of Dr. A. D. Emmett, assistant director of research of Parke, Davis and Company. Dr. Emmett, who has been in charge of the vitamin division for twenty-nine years, will become a consultant for the research department.

DR. O. S. DUFFENDACK, director of research for the North American Philips Company, Inc., previously professor of physics at the University of Michigan, has been appointed vice-president and director of research and engineering of the company. He will be responsible for all research and engineering activities. During the war he has been a director of research with the National Defense Research Committee and has served as chief of one of the sections.

SIR JACK DRUMMOND, D.Sc., F.R.S., chief scientific adviser to the British Ministry of Food, has resigned from the chair of biochemistry at University College, London, which he has held since 1922, to accept the post of director in charge of the scientific research of the Boots Pure Drug Co., Ltd. It is stated, however, that he will not take up the work until the food situation has improved.

DR. S. A. WAKSMAN, of the Agricultural Experiment Station of New Brunswick, N. J., writes to *SCIENCE* that he has received several communications from the Russian bacteriologist, S. N. Winogradsky, who has been residing during the last twenty-five years at Brie Comte-et-Robert near Paris. Professor Winogradsky, who is now eighty-nine years old, has lived through the period of German occupation under fairly tolerable conditions. He has had very little opportunity to continue his scientific work and has, therefore, devoted his time to summarizing the work that he has done during the past half-century in the field of microbiology. This summary will be published in the French language by the Pasteur Institute as soon as facilities are available.

FOLLOWING a tour of duty in the Office of the Surgeon General of more than three years, Lieutenant Colonel Harrison J. Shull, M.C., has taken up his new

assignment as consultant in medicine to the Sixth Army in the Southwest Pacific.

DR. CLAIBORNE G. LATIMER, professor of mathematics at the University of Kentucky, has accepted the invitation of the United States War Department to be one of a selected group of civilian teachers to go to England on July 1, as instructor in the University Study Center in Shrivenham, which the Army is establishing as part of the over-all educational program for troops in the European theater during the demobilization period.

DR. C. C. TAN, professor of genetics at the National University of Chekiang, China, is spending a year in the department of zoology of Columbia University as a research associate of the Rockefeller Foundation.

DR. O. R. CAUSEY and Mrs. Causey are returning to the United States in August for accumulated leave after six years in Brazil. Dr. Causey, who is a member of the field staff of the International Health Division of the Rockefeller Foundation, has been on leave of absence for the past three years for service with the Office of the Coordinator of Inter-American Affairs for the Amazon Program in Belem, Brazil. His permanent address is care of the Rockefeller Foundation, 49 West 49th Street, New York 20, N. Y.

DR. TSO-HSIN CHENG, professor of biology and dean of Fukien Christian University; Dr. Tung-chi Lin, professor of political science at Fuhtan University, Chungking; Dr. Tsi-ze Nay, director of the Institute of Physics, National Academy of Peiping, now in Kunming, and Dr. L. K. (Meng-ho) Tao, director of the Institute of Social Sciences, Academia Sinica, arrived in the United States last week. They were invited by the Department of State to spend a year in this country visiting various American universities, libraries and other cultural centers.

THE commencement address of the University of Rochester was given on June 15 by Dr. Alan Gregg, director of the Division of Medical Sciences of the Rockefeller Foundation.

UNDER the auspices of the Independent Citizens Committee of the Arts and Professions in the Post-war World a program was presented on June 22 and 23 at the Waldorf-Astoria Hotel, New York. There were twelve sections, including one on science and technology, of which Morris Llewellyn Cooke, consulting engineer, was chairman, and one on a national health and welfare program, presided over by Dr. Channing Frothingham, chairman of the Committee of Physicians for the Improvement of Medical Care. At the former, Dr. Paul Sears, professor of botany at

Oberlin College, spoke on "The Role of Science in Regional Resource Development"; Walton Hamilton, professor of constitutional law at the Yale Law School, on "Public Policy in Respect to Technology"; Dr. Walter Rautenstrauch, professor of industrial engineering at Columbia University, on "Science Opens the Door of Production," and Lieutenant Stuart Henderson Britt, U.S.N.R., on "Discovery and Development of Scientific Talent."

At a dinner of the alumni held as part of the commencement week program of the Massachusetts Institute of Technology, a gift of \$350,000 was presented to the institute by Alfred P. Sloan, Jr., chairman of the Board of the General Motors Corporation. A gift of \$100,000 was also announced from Gerard Swope, former president of the General Electric Company, to endow a group of post-graduate fellowships in the fields of physics, electrical engineering and industrial management. Fellowships awarded under this fund will go to students who have pursued courses especially planned for the education of superior students, special consideration to be given to students from St. Louis, Mo., Highland Park, N. J., and New Brunswick, N. J., or to students who are employees of the General Electric Company or their children.

THE University of Pennsylvania has received a be-

quest of \$155,000 from the estate of Dr. George E. De Schweinitz, ophthalmologist, which will be used to establish a fund to support the department of ophthalmology and a professorship that will be named "the William F. Norris and George E. De Schweinitz Professorship of Ophthalmology." Dr. Norris was the first professor of ophthalmology in the School of Medicine of the university.

DR. DUNCAN MACINNES, of the Rockefeller Institute for Medical Research, New York City, who had been appointed the first Sigma Xi lecturer-in-residence, gave a series of lectures at Cornell University during the week of May 14 under the auspices of the Cornell Chapter and of the local members of the American Chemical Society. The titles of the lectures were: "Transference Numbers and the Debye-Huckel Theory"; "The Effect of Centrifugal Force on the Potentials of Galvanic Cells"; and "The Study of Proteins by the Electrophoretic Method."

THE Johnson and Johnson Research Foundation has established an annual award at Northwestern University. This consists of a silver medal and an honorarium of \$250 to be known as the Malcolm T. MacEachern Award in honor of Dr. MacEachern, associate director of the American College of Surgeons and director of the program in hospital administration at Northwestern University.

SPECIAL ARTICLES

A SEARCH FOR VIRUS-INACTIVATING SUBSTANCES AMONG MICROORGANISMS^{1,2}

THE results of studies of the action of antibiotic agents against true viruses have been almost consistently negative. Robinson³ reported that gramicidin, tyrocidine, tyrothricin, penicillin, streptothricin, citrinin and gliotoxin are inactive against the viruses of the PR8 strain of epidemic influenza and a strain of *Lymphogranuloma venereum*; on the other hand, actinomycin exerted a slight *in vitro* inactivation of the influenza virus. Penicillin was found to be ineffective for experimental infections of vaccinia BH, St. Louis encephalitis and equine encephalomyelitis.⁴ Subtilin and other agents were useless against influenza A virus in white mice.⁵ Clavacin, in spite of the original claims, proved to be of no value in the treatment of the common cold.⁶ Penicillin and clava-

cin were recently found to be inactive against the virus of fowl pox,⁷ and aspergillie acid had no effect upon the encephalomyelitis virus.⁸

As contrasted with these negative results, certain claims have been made that filtrates of various fungi and of an undescribed species of *Actinomyces* have a high virucidal activity, both *in vitro* and *in vivo*, against the Frances strain of neurotropic yellow fever virus in mice.⁹ These claims have not been confirmed as yet.

In any attempt to isolate chemical agents active against viruses, one is faced with the fact that these substances act only in the animal body. Whereas the action of antibiotic substances against bacteria, actinomycetes and fungi can be investigated readily by employing various plate methods,¹⁰ the study of antiviral activity of various agents is complicated by the need of employing animals, tissue culture or egg

¹ Journal Series Paper, New Jersey Agricultural Experiment Station, Rutgers University, Departments of Microbiology and Poultry Husbandry.

² Supported by a grant made by the Commonwealth Fund of New York.

³ H. J. Robinson, Thesis, Rutgers University, 1943.

⁴ R. F. Parker and H. W. Dieffendorf, *Proc. Soc. Exp. Biol. and Med.*, 57: 351, 1944.

⁵ A. P. Krueger, *SCIENCE*, 98: 348, 1943.

⁶ B. H. Robbins, *Proc. Soc. Exp. Biol. and Med.*, 57: 215, 1944.

⁷ J. M. Stansfield, A. E. Francis and C. H. Stuart-Harris, *Lancet*, 247: 370, 1944.

⁸ S. E. Sulkin and A. Goth, *Proc. Soc. Exp. Biol. and Med.*, 58: 16, 1945.

⁹ H. Linhares, *O. Hospital*, 26: 327, 1944.

¹⁰ S. A. Waksman and H. B. Woodruff, *Jour. Bact.*, 40: 581, 1940.

embryo techniques, in order to determine the survival or inactivation of a virus. In the following investigations, the developing chick embryo was selected as the test animal because it has been shown to be very sensitive to infection with certain viruses¹¹ and because its defense mechanism does not develop until near the time of hatching.

By the use of the above method, considered to be sufficiently sensitive to detect even slight amounts of virus inactivation and rapid enough for testing fairly large numbers of organisms, a survey was made of 150 cultures of bacteria, actinomycetes and fungi. Only three of these organisms were found to have even a slight *in vitro* inactivating effect upon the virus of fowl pox.

Viruses and Chick Embryos: The following viruses were isolated by one of us and used in these investigations: Fowl pox FH—egg passage strain; laryngotracheitis—egg passage strain; chick bronchitis—egg passage strain.

These viruses were maintained by inoculation into the chorioallantoic membrane of 11- to 12-day-old embryonated eggs, and were stored in a freezing unit at -20°C .

Embryonated eggs from White Leghorn hens were supplied by the College Farm of Rutgers University.

Isolation of Organisms: Various natural materials served as sources for the isolation of organisms. Straw-compost, manure, field soil, material from a drain in a poultry post-mortem room, and a soil enriched over a period of seven months with concentrates of fowl pox virus were used. Samples of these materials were plated out in various dilutions on a glycerol-phosphate agar medium to which fowl pox concentrate had been added as the source of nitrogen. The virus concentrate used for the preparation of the plates and for the soil-enrichment experiments was obtained by applying the method of differential centrifugation, used by Parker and Rivers¹² in purifying vaccinia virus, to suspensions of virus prepared by grinding infected chorioallantoic membranes under sterile conditions with saline and sand. The process was found to remove over 90 per cent. of the extraneous nitrogen from the original fluid. Following incubation of the plates at 28°C , colonies of the organisms developing were transferred to nutrient agar slants.

Tests of Culture Filtrates: Culture filtrates of the various organisms were obtained as follows: The bacteria were grown in nutrient broth; the actinomycetes and fungi in nutrient and in synthetic media contain-

ing 0.2 per cent. agar; in the case of shake cultures, the agar was omitted. The bacterial filtrates were sterilized by passage through Berkefeld or Seitz filters, and the filtrates of the cultures of fungi and actinomycetes by heating at 70°C for ten minutes.

The test procedure consisted in exposing a suspension of fowl pox virus to the culture filtrates of the various organisms (usually 0.15 ml virus suspension and 4.85 ml of filtrate) at room temperature for at least five hours, and then inoculating 0.2 ml portions into 11- to 12-day-old chick embryos. Following further incubation of the eggs for six days, the embryos were harvested and the extent of infection on the chorioallantoic membrane of the test mixtures was compared to that of the controls. The amount of virus used was so regulated as to induce a countable number of lesions on the membrane. Thus, by taking averages of a number of lesions, any reduction in infection would indicate a possible *in vitro* inactivation of the virus.

The advantages of this procedure lie in the ability to grow test organisms under optimum conditions, to treat the filtrate in any desired manner and to regulate the amount of inoculum so that a slight inactivation is not masked by an overwhelming dose of virus.

Experimental Results: One hundred and forty-seven of the organisms tested had no action at all upon the virus; in some cases the infection seemed to be actually enhanced. Three organisms were found, however, to have a definite inactivating effect, although this was rather slight and seemed to be unpromising. The organisms were a strain of *Actinomyces antibioticus* (S-4) and *Trichoderma* sp., both isolated from the straw compost, and *Actinomyces* sp. isolated from a soil enriched with fowl pox virus concentrate.

A. antibioticus S-4: Repeated tests with various culture filtrates of this organism showed a definite reduction in the average number of macroscopic lesions due to fowl-pox infection, as is brought out in Table 1.

TABLE 1
EFFECT OF CULTURE FILTRATES OF A. ANTIBIOTICUS S-4 ON FOWL-POX VIRUS

| Culture medium in which organism was grown | No. of eggs | Average number of lesions per membrane |
|--|-------------|--|
| Glucose-tryptone | 10 | 4 |
| Glycerol-phosphate + virus concentrate | 4 | 7 |
| Nutrient broth | 7 | 9 |
| Starch-tryptone | 7 | 10 |
| Control | 5 | 26 |

Extracts obtained from the culture filtrates of this organism by treatment with ether were active in the *in vitro* tests against fowl pox and laryngotracheitis, but inactive against chick bronchitis. Because of the

¹¹ F. M. Burnet, E. V. Keogh and D. Lush, *Austral. Jour. Exp. Biol. and Med.*, 15: 227, 1937.

¹² R. F. Parker and T. M. Rivers, *Jour. Exp. Med.*, 62: 65, 1935.

ough toxicity of actinomycin, the active principle produced by this organism, further studies of its *in vivo* activity were hardly justified (Tables 2, 3).

TABLE 2

EFFECTS OF ACTINOMYCIN ON SURVIVAL OF FOWL POX VIRUS*

| Number of eggs | Actinomycin per embryo, gammas | Survivors after 6 days | Average no. lesions |
|----------------|--------------------------------|------------------------|---------------------|
| 8 | 4 | 6 | 10 |
| 10 | 8 | 9 | 5 |
| 8 | 16 | 6 | 6 |
| 6 | 40 | 2 | 4 |
| 5 | 200 | 0 | 15 |
| 16 | 0 | 8 | 15 |

* In all cases virus was exposed to a concentration of actinomycin which was five times greater than that finally inoculated into the eggs.

TABLE 3

EFFECTS OF ACTINOMYCIN OF THE SURVIVAL OF THE VIRUS OF LARYNGOTRACHEITIS

| Number of eggs | Gammas per egg | Number of embryos alive after* | | Type of infection |
|----------------|----------------|--------------------------------|-------------|--|
| | | 3 days | 5 days | |
| 10 | 10 | 3 | 5 | reduced size of lesions |
| 10 | 20 | 7 | 1 | reduced size and number of lesions |
| 10 | 30 | 6 | 3 (2 dying) | lesions fewer, smaller and more discrete |
| 10 | 0 | 8 | 4 | full infection; pronounced opaque primary and large areas of confluent secondary lesions |

* Increase in deaths of treated eggs was due to the toxicity of the actinomycin. Examination of these eggs at five days revealed that the embryos had died only a short time before; therefore both living and dead embryos were considered in the analysis.

It is of interest that this organism produced typical actinomycin A, which was readily isolated in crystalline form.¹³ The product formed orange-red crystals melting at 250°. A mixed melting point with actinomycin A obtained from the original *A. antibioticus* 3435 showed no depression. Determination of antibacterial activity also indicated that the two substances were identical. No antiviral or antibacterial activity was present in the B-fraction or in the aqueous residue after ether extraction. This shows that the antiviral activity of the organism was confined to the actinomycin A produced by it.

A comparison was next made of the purified actinomycin A isolated from the S-4 and 3435 strains.¹⁴ Both had an *in vitro* inactivating effect; preliminary tests tended to indicate that the product obtained

from the S-4 strain produced less toxic effects, i.e., less necrosis at the point of inoculation and fewer necrotic secondary lesions (lesions on the chorio-allantois other than those formed at the site of inoculation).

No attempt was made to use the substance as a therapeutic agent against experimental fowl pox infections.

Trichoderma sp. 117-15: In eight out of eleven tests made with this organism grown on several culture media, a definite *in vitro* destruction of the fowl pox virus appeared to be indicated (Table 4). In

TABLE 4

IN VITRO EFFECTS OF CULTURE FILTRATES OF TRICHODERMA SP. AND ACTINOMYCETES SP. UPON FOWL POX VIRUS

| Medium | Days | Condition of growth | Final pH | Inactivation of virus† |
|-----------------------------|------|---------------------|----------|------------------------|
| <i>Trichoderma</i> filtrate | | | | |
| NA* | 7 | Static | 7.9 | - |
| NA | 11 | Static | 7.9 | + |
| GTA | 3 | Static | 7.9 | (?) |
| GTA | 12 | Static | .. | + |
| GT | 6 | Shaken | 3.9 | complete |
| GT | 7 | Static | 4.9 | (?) |
| GT | 11 | Static | 6.8 | + |
| ST | 11 | Static | 7.8 | - |
| CS | 5 | Static | 4.9 | + |
| CS | 7 | Static | 4.7 | - |
| CS | 11 | Static | 7.2 | (?) |
| <i>Actinomyces</i> filtrate | | | | |
| NB | 5 | Shaken | 7.8 | - |
| NA | 7 | Static | 7.8 | - |
| NA | 11 | Static | 7.2 | + |
| NA | 11 | Static | .. | (?) |
| GT | 5 | Shaken | 4.3 | - |
| GT | 7 | Static | 4.3 | - |
| GT | 11 | Static | 4.5 | (?) |
| GT | 24 | Static | .. | (?) |
| ST | 5 | Shaken | 7.2 | - |
| ST | 7 | Static | 7.9 | - |
| ST | 11 | Static | 6.6 | + |

* NA = nutrient agar (0.2%); NB = nutrient broth; GTA = glucose-tryptone agar; GT = glucose-tryptone broth; ST = starch tryptone; CS = corn steep brown sugar medium.

† (?) = questionable reduction of the number of lesions due to the virus; + = reduction; - = no reduction.

one of the cases, the infection was completely wiped out (no lesions were visible); however, since the pH of the filtrate tested had fallen to 3.9, the possible effect of the acid reaction was indicated.

Tests of the survival of the virus in various buffer solutions from pH 3.0 to pH 10.0 indicated that the concentrates of the virus are stable between pH 4.4 and 8.0. Above and below these values they undergo a progressive inactivation. At pH 3.9, the infection is definitely decreased.

Trichoderma was found to produce a substance inhibiting the growth of *B. subtilis* and *S. aureus*, especially in filtrates obtained from peptone-dextrose media.

¹³ S. A. Waksman and M. Tishler, *Jour. Biol. Chem.*, 142: 519, 1942.

¹⁴ S. A. Waksman and H. B. Woodruff, *Jour. Bact.*, 42: 231, 1941.

Actinomyces sp. P-12: The production of an antiviral factor by this *Actinomyces* is shown in Table 4. Only five of the eleven tests indicated promise. The organism grew slowly in culture media, and no culture filtrate less than 11 days old showed any activity whatsoever. These filtrates showed no antibacterial action, although on dextrose-asparagine agar medium the organisms inhibited, by a streak test method, *S. aureus* and *B. subtilis*, but not *E. coli* and *S. lutea*.

Although these results indicate the possibility of detecting antiviral or virus-inactivating substances produced by microorganisms, no claims can be made as to the practical promise even of the three organisms discussed above. Actinomycin A is known to be highly toxic. The other two organisms have not been sufficiently studied to warrant any further statements concerning their antiviral properties.

Even the *in vitro* activity of a substance does not necessarily indicate any therapeutic potentialities, since the substance must be non-toxic, should not be inhibited by body fluids and should be able to act where virus infection occurs, namely inside the living cell.

SUMMARY

One hundred and fifty organisms, comprising bacteria, fungi and actinomycetes, were isolated from straw-compost, manure, soil, drainage material and soil enriched with virus concentrates, and were tested for antiviral activity *in vitro*. Three of these organisms gave indications of possible inactivation of some of the fowl pox virus, and, in one case, of the laryngo-tracheitis virus. The active principle of one of these organisms was actinomycin A, an antibacterial substance known to be highly toxic to animals. The other two organisms were less extensively studied, and no claims regarding their antiviral potentialities can be made at present.

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CRYSTALLIZATION OF A TRYPSIN INHIBITOR FROM SOYBEAN¹

THE presence of a protease inhibitor in soybean has been recently reported by Ham and Sandstedt² and by Bowman.³

¹ This work was initiated at the suggestion of Major I. A. Mirsky in connection with his studies on streptococcal fibrinolysin (see *SCIENCE*, 100: 198, 1944).

The present communication deals with the isolation from cold-processed defatted soybean meal of a crystalline protein which inhibits the proteolytic action of trypsin.

Unlike the crystalline inhibitor isolated from beef pancreas⁴ the soybean inhibitor is precipitated when heated in 2.5 per cent. solution of trichloroacetic acid, and it does not diffuse through collodion or Cellophane membranes. It contains about 16 per cent. nitrogen and less than 0.01 per cent. of phosphorus. It is a protein of the globulin type, soluble in dilute acid, alkali or salt solution. Its minimum solubility in water is in the range of pH 4.2 to 4.8.

The light absorption spectrum of a solution of the crystalline soybean inhibitor is that of a typical protein with a maximum absorption at 2,800 Å and a minimum at 2,520 Å. It is free of carbohydrate, as tested by the Molisch reagent on one per cent. solution of the protein.

The trypsin inhibitory activity per mg of the material is not altered on repeated crystallization. It has very little inhibiting power on the proteolytic or the milk-clotting activity of chymotrypsin.

METHOD OF ISOLATION

The method of isolation of the inhibitor from soybean meal⁵ consists essentially of the following steps:

- (1) Washing of the meal with 80 per cent. alcohol.
- (2) Extraction in 0.25 N H₂SO₄ in the proportion of 5 liters of acid per 1,000 gm of meal.
- (3) Adsorption of the inhibitor from the acid extract on bentonite and elution with 5 per cent. solution of pyridine in water.⁶
- (4) Precipitation of the inhibitor in amorphous form by titration to pH 4.4 at 10° C. after removal of the pyridine by dialysis.
- (5) Crystallization at pH 5.0 and 35° C. This step consists in suspending the amorphous precipitate in twice its weight of water, warming the suspension to about 40° C., and titrating it with 1 N NaOH to pH 5.0 (tested with methyl red by the drop method on a test plate). The amorphous precipitate gradually dissolves, while crystals in the form of fine short needles and thin hexagonal plates appear.

² Wendell E. Ham and R. M. Sandstedt, *Jour. Biol. Chem.*, 154: 505, 1944.

³ Donald E. Bowman, *Proc. Soc. Exp. Biol. and Med.*, 57: 139, 1944.

⁴ M. Kunitz and John H. Northrop, *Jour. Gen. Physiol.*, 19: 991, 1936.

⁵ Soybean meal, Nutrisoy XXX, in the form of flakes supplied by the Archer-Daniels-Midland Co., Chicago, Ill., was used throughout this work. The use of this meal was kindly suggested by Dr. M. L. Anson.

⁶ The bentonite procedure was suggested by the work of G. Alberton, W. H. Ward and H. L. Fevold on "Crystallization of Lysozyme from Egg White," *Jour. Biol. Chem.*, 157: 43, 1945.

the same time. The crystallization is complete within a few hours if the solution is kept at about 35° C.

(6) Recrystallization. This consists in re-precipitating the protein at pH 4.4 and 10° C. from a relatively dilute solution of the crystals in water and then proceeding as described in (5). The inhibitor can also be recrystallized from 20 per cent. alcohol at pH 5.0.

The details of the method of isolation are to be described in a future publication.

Further studies are being made on the mechanism of the trypsin-inhibiting action of the new crystalline protein and also on some of its physical and chemical properties.

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ELECTROPHORETIC STUDIES IN RHEUMATIC FEVER¹

RECENT summaries of available clinical and epidemiological knowledge concerning rheumatic fever^{2, 3} and investigations of this disease⁴ indicate that rheumatic fever may not be a specific infectious disease but may be the result of a response on the part of the host to external stimuli which is different from the response to the same stimuli of individuals who do not develop rheumatic fever. Attempts have been made to correlate the occurrence of rheumatic fever with the antibody response of the host to infection with the group A- β hemolytic streptococcus, and these have been recently summarized.⁵

In considering this matter in a broader fashion, it is known that the measurement of serum antibodies is one method of determining the reaction of the host to external stimuli. Since it is also known that serum antibodies are for the most part found in the gamma globulin fraction of human serum⁶ it seemed desirable

¹ From the Bureau of Laboratories, Department of Health, City of New York; the Lederle Laboratories, Pearl River, New York, and the Kings County Hospital, Brooklyn, New York. This article was accepted for publication on January 29.

² May G. Wilson, "Rheumatic Fever," New York: The Commonwealth Fund; London: Oxford University Press, 1940.

³ John R. Paul, "The Epidemiology of Rheumatic Fever and Some of Its Public Health Aspects," New York: The American Heart Association, Second Edition, Metropolitan Life Insurance Company Press, 1942.

⁴ M. G. Wilson, M. D. Schweitzer and R. Lubschez, *Jour. Pediat.*, 22: 468 and 581, 1943. A. R. Rich and J. E. Gregory, *Bull. Johns Hopkins Hosp.*, 73: 239 and 465, 1943. H. Selye, O. Sylvester, C. E. Hall and C. P. Leblond, *Jour. Am. Med. Assn.*, 124: 201, 1944. M. G. Wilson, *Jour. Am. Med. Assn.*, 124: 1188, 1944.

⁵ J. R. Paul, *loc. cit.*, p. 24.

⁶ E. J. Cohn, J. L. Oneley, L. E. Strong, W. L. Hughes, Jr. and S. H. Armstrong, Jr., *Jour. Clin. Invest.*, 23: 417, 1944. J. F. Enders, *Jour. Clin. Invest.*, 23: 510, 1944.

to determine whether the gamma globulin fraction of patients suffering from rheumatic fever was different from that of normal individuals.

Isolated reports of electrophoretic studies in rheumatic fever indicate abnormalities in the gamma globulin fraction. Longworth, Shedlovsky and MacInnes⁷ included three specimens from cases of rheumatic fever among those from a large number of diseases without specifying stage of activity, and reported the gamma-albumin ratio to be elevated in all three patients. Luetscher⁸ performed a similar study on a number of diseases and reported that a specimen from each of two cases of acute rheumatic fever with rheumatic heart disease and congestive failure contained a greater than normal amount of gamma globulin expressed as grams per hundred milliliters of plasma. In addition he stated that a specimen from one "old case" of rheumatic heart disease showed a similar change but no quantitative result was reported for that case.

METHOD OF STUDY

Electrophoretic patterns were obtained from the various sera in the Tiselius apparatus by using the "Schlieren-scanning method of Longworth."^{9, 7} Before electrophoresis the sera were diluted 1:4 or 1:6 with buffer solution of pH 7.6 containing 0.15 M. NaCl and 0.02 M. sodium phosphate and dialyzed against large volumes of this buffer at +2° C. Measurements were made by a planimeter of the areas under the various peaks in the photographic record for computing the relative amounts of the various components present, using the patterns for the descending boundaries. The total protein content of the sera was determined by micro-kjeldahl nitrogen analysis.

RESULTS OF THE STUDY

As indicated in Table 1, the ratios of gamma globulin to albumin, and gamma globulin to total protein in nine specimens of serum from eight patients in the acute stages of the disease are elevated above "normal"¹⁰ without exception, although one of these, serum (line 8, table 1), is at the upper limit of normal. Electrophoretic analysis of the serum in three of the same patients during inactivity of the disease show continued elevation of these ratios at a lower level. Four specimens from three individuals not suffering

⁷ L. G. Longworth, T. Shedlovsky and D. A. MacInnes, *Jour. Exp. Med.*, 70: 399, 1939.

⁸ J. A. Luetscher, Jr., *Jour. Clin. Invest.*, 19: 313, 1940.

⁹ L. G. Longworth, *Jour. Am. Chem. Soc.*, 61: 529, 1939.

¹⁰ H. Svensson, *Kolloid Ztschr.*, 87: 181, 1939. J. A. Luetscher, Jr., *Jour. Clin. Invest.*, 20: 99, 1941. D. H. Moore and J. Lynn, *Jour. Biol. Chem.*, 141: 819, 1941. V. P. Dole, *Jour. Clin. Invest.*, 23: 708, 1944.

TABLE 1

| Name | Diagnosis | Class | Drug therapy | Outcome | Total protein (grams per cent.) | Electrophoretic analysis of serum | | | | | | | |
|--------|--|-------|---|------------------------------------|---------------------------------|-----------------------------------|-----------------------|---------|----------|-----------------|--------------------|-------------------|------------------------|
| | | | | | | Areas | | | | Total per cent. | $\frac{\gamma}{A}$ | T.P. (gm/100 ml.) | $\frac{\gamma}{Total}$ |
| | | | | | | α | $\alpha_1 + \alpha_2$ | β | γ | | | | |
| F.Q. | Acute R.F. R.H.D.-M.S.- M.I. | I-E | None* | Rec. | ... | 113 | 17 | 28 | 38 | 19.4 | 0.34 | ... | .15 |
| F.Q. | R.H.D.-M.S.- M.I. | I-A | None | Rec. | 7.50 | 123 | 17 | 26 | 31 | 15.7 | 0.25 | 1.17 | .14 |
| J.C. | Acute R.F. R.H.D.-M.I. | I-E | None* | Rec. | 7.62 | 76 | 30 | 28 | 53 | 28.4 | 0.70 | 2.16 | .39 |
| J.C. | R.H.D.-M.I. | I-A | None | Rec. | 7.37 | 113 | 14 | 20 | 33 | 18.3 | 0.29 | 1.35 | .12 |
| G.S. | Acute R.F. R.H.D.-M.I. | II-E | None* | Rec. | 8.50 | 119 | 18 | 28 | 54 | 24.8 | 0.45 | 2.12 | .15 |
| G.S. | R.H.D.-M.I. | II-B | None | Rec. | 7.25 | 109 | 10 | 21 | 42 | 23.0 | 0.39 | 1.67 | .09 |
| R.S. | Acute R.F. R.H.D.-M.S.- M.I. | II-E | None* | ? | ... | 74 | 20 | 33 | 52 | 29.0 | 0.70 | ... | .27 |
| R.S. | Acute R.F. R.H.D.-M.S.- M.I. | II-E | Salicylates | ? | 7.25 | 76 | 31.5† | 17.5 | 14.0 | 0.23 | 1.02 | .. | |
| A.L. | Acute R.F. R.H.D.-M.I. | I-E | None | Rec. | 7.75 | 75 | 24 | 25 | 51 | 29.3 | 0.68 | 2.27 | .32 |
| J.M. | Acute R.F. R.H.D.-M.I. | II-E | Small doses salicylates | Rec. | 8.12 | 98 | 29 | 30 | 45 | 22.2 | 0.46 | 1.80 | .30 |
| S.C. | Acute R.F. R.H.D.-M.S.- M.I. | IV-E | Massive doses of salicylates and treatment for congestive failure | Died 2 days after sample was taken | 7.25 | 61 | 41 | 24 | 44 | 25.9 | 0.72 | 1.88 | .67 |
| V.V. | Acute R.F. (Sed rate) R.H.D.-M.S.- M.I. | II-E | None | Rec. | 7.00 | 118 | 13 | 24 | 33 | 17.6 | 0.28 | 1.23 | .11 |
| D.R. | Control | .... | .... | .... | 7.75 | 131 | 17 | 38 | 26 | 12.0 | 0.20 | 0.93 | .13 |
| D.R. | Control | .... | .... | .... | 7.50 | 120 | 46† | 23 | 12.2 | 0.19 | 0.92 | .. | |
| K.J.T. | Control | .... | .... | .... | 7.37 | 78 | 7 | 28 | 14 | 11.0 | 0.18 | 0.81 | .09 |
| B.D. | Control | .... | .... | .... | 7.37 | 68 | 41† | 25 | 18.6 | 0.37 | 1.37 | .. | |

* Salicylate therapy began after taking of specimens.

† $\alpha_1 + \alpha_2 + \beta$.

from rheumatic fever analyzed in the same electrophoretic cell reveal ratios similar to those reported for normals in the literature in three, and the serum in one (line 16, table 1), was found to be abnormal. The alpha globulin-albumin ratios reported as being increased in cases of febrile disease⁷ are less consistently elevated in the specimens analyzed in this study.

It is appreciated that the reported results are only suggestive and much further work along these lines remains to be done. The reported changes may be just another non-specific manifestation of rheumatic fever. However, this method of study offers a quantitative approach not heretofore available in the study of the mechanism of this obscure disease, since it is possible to study in quantitative fashion a constituent of the blood which is found in increased amounts in rheumatic fever.

SUMMARY AND CONCLUSIONS

Electrophoretic analysis of specimens of the blood

serum of a small number of cases of rheumatic fever during the "active" and "inactive" stages of the disease show consistent increases above "normal" in the gamma globulin fraction of the serum.

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URONIC ACIDS IN ANIMAL BODIES

It is known generally that quantitative methods for estimating glucuronic acid in biological materials are not specific but may include other uronic acids. In spite of this, much of the literature on the subject ignores the possibility that galacturonic acid and its salts may also be present in animal tissues and fluids. There is perhaps justification, in the case of the carnivore, for considering the uronic acid as glucuronic. This assumption is not justified for the herbivore where it is known that the diet is rich in polygalacturonic compounds in the form of pectic substances. (Pectin "consists chiefly of partially

methoxylated polygalacturonic acids," as mentioned in the National Formulary VII, p. 316.)

This point is confirmed and made more clear by observations made in this laboratory in connection with studies on the transfusion treatment of shock with pectin sols^{1, 2, 3} (autoclaved and clarified for control of molecular size and sterility). Our previously published method⁴ has made it possible to obtain the data on the uronic acid contents of livers, as given in table 1.

TABLE 1

| Source of samples | Mg uronic acid per gram of liver | | Remarks |
|---|--------------------------------------|---------|--|
| | Individual specimens | Average | |
| uckling rabbits (composite sample from 4 animals) | ... | 1.5 | Note increase in uronic acid content when diet changes to include plant material known to contain galacturonic acid. |
| Adult rabbits (on commercial rabbit ration) | 17.3 38.5 28.3 19.0 27.2 | 26.1 | (Herbivorous) |
| Human, normal adults | 5.6 7.3 4.4 | 5.8 | (Omnivorous) |

The uronic acid in infant rabbit livers is no doubt glucuronic, but the tremendous increase following the use of a diet containing grains, alfalfa and other plant material must certainly result from galacturonic rather than glucuronic.

The logical conclusions from this would be that in the omnivorous human the uronic acids in tissues and fluids would also include galacturonic. Thus, intravenously injected pectin (a polygalacturonide) would not be a source of substances as foreign to the human body as would some of the other plasma substitutes which have been given consideration. This is in harmony with reports that a considerable proportion of injected acacia remains in the liver,⁵ a situation not found with pectin,¹ a substance of easily hydrolyzable galacturonide nature. Spleen enlargement and alter-

ation may take place in some cases immediately after pectin injection,^{6, 7} but there is later a return to normal.⁸

The significance of the distribution of the individual uronic acids in tissues of animals having different basic feeding habits offers an interesting field of study. A consideration of this general subject would lead to a better understanding of human metabolism.

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PRODUCTION OF GLYCOSURIA IN NORMAL RATS BY MEANS OF ADRENOCORTICOTROPHIC HORMONE¹

THE production of glycosuria and hyperglycemia in normal rats by the administration of large amounts of 17-hydroxycorticosterone and 17-hydroxy-11-dehydrocorticosterone has been reported.^{2, 3} We have been able to duplicate these effects with pure adrenocorticotrophic hormone.

Normal male rats of the Sprague-Dawley strain having an initial weight of 300 grams were force-fed a fluid diet which represented approximately 15 grams of available carbohydrate per day. The adrenocorticotrophic hormone was prepared by the procedure described by Li, Evans and Simpson.⁴ Following a control period of ten days the hormone was injected subcutaneously in amounts of 1 mg every two hours until a total of 7 mg per day had been administered. Five rats were injected with the hormone for ten days. As shown in Fig. 1, four of the five animals developed glycosuria on the second day following the beginning of injection and it was continued as long as the hormone was given. One of the rats did not develop glycosuria, although it showed a marked hyperglycemia following feeding. Two of the rats were killed at the end of the injection period. Weights for pairs of adrenal glands of 146.5 and 131.1 mg were recorded. Control weights averaged 36 mg with a

⁶ Data being prepared for publication by the Hektoen Institute of Cook County Hospital, Chicago.

⁷ H. Popper, B. W. Volk, K. A. Meyer, D. D. Kozoll and F. Steigmann, *Proc. Cent. Soc. Clin. Res.*, 17: 9 and 10, Chicago, November 3-4, 1944.

⁸ Work now in progress in our laboratory.

¹ From the Upjohn Research Laboratories, Kalamazoo, Michigan, and the Institute of Experimental Biology, University of California, Berkeley, California.

² D. J. Ingle, *Endocrinology*, 29: 649, 1941.

³ D. J. Ingle, G. B. Ginther, J. S. Evans, A. N. Wick and M. H. Kuizenga, *Federation Proceedings*, 2: 23, 1943.

⁴ C. H. Li, H. M. Evans and M. E. Simpson, *Jour. Biol. Chem.*, 149: 413, 1943.

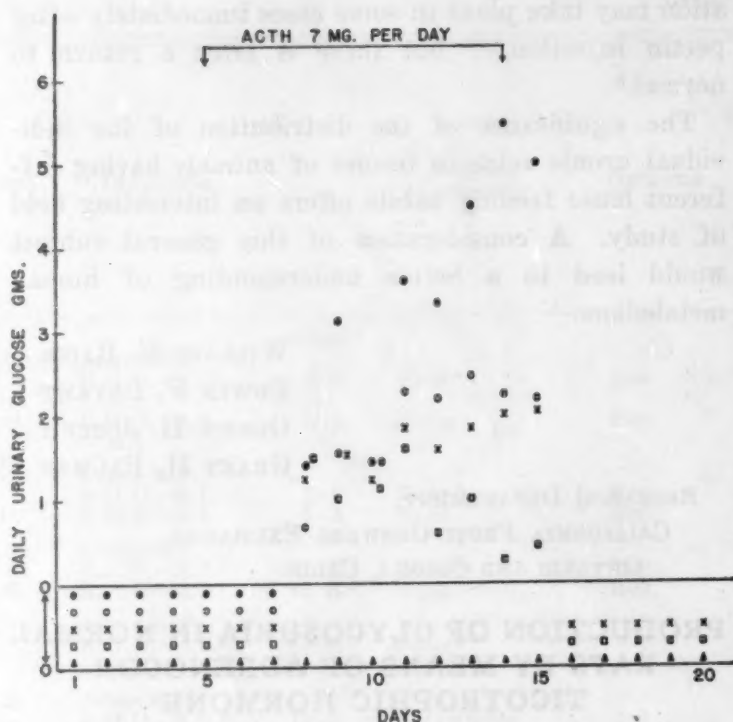
¹ E. F. Bryant, G. H. Palmer and G. H. Joseph, *Proc. Soc. Exp. Biol. and Med.*, 49: 279-82, 1942.

² D. D. Kozoll, G. H. Joseph, B. W. Volk, F. Steigmann and H. Popper, *Proc. Cent. Soc. Clin. Res.*, 17: 47, Chicago, November 3-4, 1944.

³ K. A. Meyer, D. D. Kozoll, H. Popper and F. Steigmann, *Surg. Gynecol. and Obstet.*, 78: 327-32, 1944.

⁴ E. F. Bryant, G. H. Palmer and G. H. Joseph, *Ind. Eng. Chem. Anal. Ed.*, 16: 74-76, 1944.

⁵ M. Andersch and R. B. Gibson, *Jour. Pharmacol.*, 52: 407, 1934.



range of 32 to 43 mg. Three rats were observed for seven days following withdrawal of the hormone. The glycosuria immediately disappeared from the two animals which had excreted glucose during the injection period.

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STRAIN ENERGIES OF CYCLIC HYDROCARBONS¹

THE strain energies of cyclic hydrocarbons have long been of interest to chemists. Since the discovery of appreciable energy barriers to rotation about single bonds, it has been apparent that this phenomenon may contribute a strain energy² in addition to the long-recognized deviation from tetrahedral bond angles. Conn, Kistiakowsky and Smith² discussed the relative energy contents of five- and six-membered cyclic hydrocarbons with zero, one and two double bonds without being able to obtain agreement between calorimetric values and theory. It is the purpose of this communication to point out that by recognizing the non-planarity of the cyclopentane ring³ it is possible to obtain substantial agreement.

The calculations leading to the values in Table 1 are based on the well-established (though not very

¹ The material in this communication was presented as a part of the American Chemical Society Award in Pure Chemistry address, Pittsburgh, 1943. Publication and further work have been delayed by war activities.

² J. B. Conn, G. B. Kistiakowsky and E. A. Smith, *Jour. Am. Chem. Soc.*, 61: 1868, 1939. These authors state that Dr. V. Schomaker first suggested this possibility to them.

³ J. G. Aston, H. L. Fink and S. C. Schumann, *Jour. Am. Chem. Soc.*, 65: 341, 1943.

TABLE 1
STRAIN ENERGIES (KCAL. PER MOLE)

| | Bond angles | Single bond twist | Total calc. | Exper. |
|--------------------------|-------------|-------------------|-------------|--------|
| Cyclopentane | 2.6 | 6.6 | 9.2 | 7 |
| Cyclopentane (planar)* | (0.1) | (14.0) | (14.1)* | (7) |
| Cyclopentene | 2.6 | 5.6 | 8.2 | 6 |
| Cyclopentadiene-1, 3 | 7 | 0 | 7 | 6 |
| Cyclohexane (chair form) | 0 | 0 | 0 | (0) |
| Cyclohexane (boat form)* | (0) | (5.6) | (5.6)* | (0) |
| Cyclohexene | 0 | 1.5 | 1.5 | 1 |
| Cyclohexadiene-1, 3 | 0 | 4 | 4 | 4 |

* Hypothetical, unstable forms.

precise) values of 2,800 cal. per mole for the potential barrier⁴ about an ethane-like single bond (staggered position having minimum energy) and 6×10^{-10} erg per radian² for the force-resisting⁵ distortion of the bond angles about a carbon atom. Several amounts and types of puckering of cyclopentane were considered in order to estimate the energy of the stable position. In the column headed "Bond Angles" are given the energies needed to bend the bond angle below their equilibrium values. To compute the twist energy, each single bond in the ring is considered separately. The energy needed to twist an ethane molecule into a similar configuration is taken as the contribution for that bond. In considering orientations adjacent to the double bond in the olefins, it is assumed that the equilibrium position is still the staggered one (if two single bonds were bent into a two-membered ring). This is confirmed by results for the simpler olefins. While the agreement in Table 1 is not perfect, it is within the various uncertainties present.

The experimental values in Table 1 are based on hydrogenation data² for the olefins and on combustion data⁶ for the two naphthenes. The basic, no-strain heat of olefin hydrogenation is taken as that of trans-2-butene. For the diene hydrogenation, the value for 1,3-butadiene is adjusted for the effect of substitution on each end with the trans-2-butene-ethylene difference.

It is planned, when circumstances permit, to refine these calculations by detailed consideration of the force constants and spectra of the molecules involved. At that time additional details of these calculations can be given.

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⁴ K. S. Pitzer, *Chem. Rev.*, 27: 39, 1940.

⁵ Rough average of values given by T. Y. Wu, "Vibration Spectra and Structure of Polyatomic Molecules," National University of Peking, Kun-ming (1939).

⁶ H. M. Huffman, private communication.

INCREASING AND PROLONGING BLOOD PENICILLIN CONCENTRATIONS FOLLOWING INTRAMUSCULAR ADMINISTRATION¹

Two general methods have been employed in maintaining effective blood levels of penicillin following intramuscular administration; those which delay the absorption of a large dose and those which delay excretion of penicillin. Delayed absorption has been accomplished by giving the penicillin in oil,² in beeswax-peanut oil³ mixtures, in gelatin,⁴ by local ice packs⁵ and with a vasoconstrictor such as adrenalin.⁶ Delayed excretion has been effected by the simultaneous administration of diodrast,⁷ para-aminohippuric acid^{8, 9} and has been observed in subjects with renal failure.¹⁰ Penicillin administered under these conditions may result in a blood level two to four times as high as that obtained by intramuscular injection every 2 to 4 hours. Although 0.03-0.06 units per cc of serum obtained by conventional methods have been considered to be therapeutically effective,^{11, 12, 13} this range of concentration does not exceed the sensitivity level of many of the commonly encountered pathogenic micro-organisms. Furthermore, in certain chronic diseases such as subacute bacterial endocarditis and osteomyelitis it is desirable to maintain higher levels over long periods of time. Since large amounts of penicillin and technical difficulties in administration are factors in obtaining high blood levels, a simple means of obtaining increased blood levels on lower dosages should be useful.

Following the observation that para-aminohippuric acid competes with penicillin for excretion in renal tubules^{8, 9} as has been suggested previously for diodrast and related compounds,⁷ the writers have used

¹From the Medical Service of the Peter Bent Brigham Hospital and the Department of Medicine, Harvard Medical School, Boston.

²G. W. Raiziss, *SCIENCE*, 100: 412, 1944.

³M. J. Romansky and G. E. Rittman, *SCIENCE*, 100: 40, 1944.

⁴W. M. Parkins, M. Wiley, J. Chandy and H. A. Zinner, *SCIENCE*, 101: 203, 1945.

⁵M. Trumper and A. M. Hutter, *SCIENCE*, 100: 432, 1944.

⁶R. T. Fisk, A. G. Foord and G. Alles, *SCIENCE*, 101: 4, 1945.

⁷C. H. Rammelkamp and S. E. Bradley, *Proc. Soc. Exp. Biol. and Med.*, 53: 30, 1943.

⁸K. H. Beyer, R. Woodward, L. Peters, W. F. Verwey and P. A. Mattis, *SCIENCE*, 100: 107, 1944.

⁹K. H. Beyer, H. Flippin, W. F. Verwey and R. Woodward, *Jour. Am. Med. Assn.*, 126: 1007, 1944.

¹⁰C. H. Rammelkamp and C. S. Keefer, *Jour. Clin. Invest.*, 22: 425, 1943.

¹¹W. E. Herrell, D. R. Nichols and D. H. Heilman, *Jour. Am. Med. Assn.*, 125: 1003, 1944.

¹²C. S. Keefer, R. Dubos, J. S. Lockwood and E. K. Marshall, *Clinics*, 2: 1077, 1944; and C. S. Keefer, W. T. Brown and C. Lyons, *Clinics*, 2: 1094, 1944.

¹³A. J. Quick, *Jour. Am. Med. Assn.*, 124: 1219, 1944.

benzoic acid administered orally to accomplish the same purpose. Benzoic acid is detoxified in the normal liver by conjugation with glycine to form hippuric acid. Sodium benzoate has had extensive use in the treatment of rheumatic fever when salicylates can not be used. Daily doses of 12 gm over long periods of time and as much as 50 gm during 1 day have been given without untoward effects.¹³ The penicillin blocking power of benzoic acid, however, may be small on an unrestricted diet. For this reason, fluid and salt restrictions have been combined with benzoic acid therapy (Table 1).

TABLE 1

| | G.McL. (I) | M.L. (II) | W.G. (I) | J.M. (I) | W.J. (III) | P.DeG. (II) |
|---|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| Penicillin dosage | 20,000 u. q 2h | 10,000 u. q 4h | 20,000 u. q 2h | 20,000 u. q 2h | 20,000 u. q 3h | 20,000 u. q 3h |
| Penicillin with normal fluids and normal diet | | | | | | |
| 30 min. level . | 0.14 | 0.14 | 0.14 | 0.28 | 0.28 | |
| 60 " " . | 0.07 | 0.07 | 0.07 | 0.14 | 0.07 | |
| 90 " " . | 0.07 | | 0.07 | 0.07 | trace | |
| 120 " " . | trace | | trace | trace | 0.0 | |
| 180 " " . | | | | | 0.0 | |
| 2 hr. urine excr. 56% | | | | | 54.4% | |
| Penicillin with low fluids and low salt diet | | | | | | |
| 30 min. level . | 0.28 | | 0.28 | 0.56 | 0.28 | 0.28 |
| 60 " " . | 0.14 | | 0.21 | 0.28 | | 0.11 |
| 90 " " . | | | | | 0.14 | |
| 120 " " . | 0.07 | | 0.11 | 0.11 | | trace |
| 180 " " . | 0.0 | | | | trace | |
| 2 hr. urine excr. 50.4% | | | | | 48.8% | |
| Penicillin with normal fluids and normal diet plus benzoic acid | | | | | | |
| 30 min. level . | 0.28 | 0.28 | 0.56 | 0.56 | 0.28 | |
| 60 " " . | 0.14 | 0.14 | 0.28 | 0.28 | | |
| 90 " " . | | | | | 0.14 | |
| 120 " " . | 0.07 | | 0.14 | 0.14 | | |
| 180 " " . | trace | | | | 0.0 | |
| 2 hr. urine excr. 46% | | | | | 49.4% | |
| Penicillin with low fluids and low salt diet plus benzoic acid | | | | | | |
| 30 min. level . | 1.12 | | 1.12 | 1.12 | 0.56 | 0.56 |
| 60 " " . | 0.56 | | 0.56 | 0.56 | 0.28 | 0.28 |
| 90 " " . | | | | | 0.11 | |
| 120 " " . | 0.28 | | 0.28 | 0.28 | | 0.07 |
| 180 " " . | 0.11 | | | | 0.0 | |
| 2 hr. urine excr. 22.4% | | | | | 46% | |

(I) = Subacute bacterial endocarditis.

(II) = Gonococcal arthritis.

(III) = Syphilis.

Methods: Benzoic acid crystals were given as a suspension in a sweet gelatin dessert or in acacia flavored with syrup of orange to prevent local irritation of the throat during ingestion, or in 0.6 gm gelatin capsules. The usual dose was 2.5 gm or 4 capsules every 4 hours. Most patients preferred the capsules. Sodium penicillin 20,000 units in 2 cc of physiological saline was given intramuscularly every 2 or 3 hours. Penicillin levels were determined on the serum of freshly drawn blood which was allowed to clot before centrifugation. The assays were done by the broth dilution tube method of titration using a standard culture of *Staphylococcus aureus*. Control levels following single intramuscular injections of penicillin in saline agreed closely with those for the same doses reported

by other investigators.^{10, 11, 12, 14} During the control period the patients were placed on a daily intake of 1,500 to 2,000 calories with the diet containing 6 to 10 gm of salt and a fluid intake of 2,500 to 3,000 cc. Penicillin levels were determined after the third day of this regimen. During combined treatment the penicillin was given 20 to 30 minutes after the benzoic acid. At first sodium benzoate was tried, but it was found that the added base neutralized the effects of a controlled salt intake, and in addition the dose of sodium benzoate proved to be somewhat nauseating. On the normal diet 2.5 gm of benzoic acid equalled 6 gm of sodium benzoate in raising the serum penicillin level. During diet restrictions which were in effect 3 days before penicillin levels were determined, the patients received the same caloric intake as previously, but fluids were limited to 1,000 to 1,500 cc a day and salt to 3 gm or less a day. On the restricted fluid intake the urine volume commonly fell to 400 to 600 cc in 24 hours.

Six patients have been studied so far in this series. In addition to determining the degree of elevation and effective maintenance of blood levels, urine levels were done to check the per cent. excretion of penicillin in a 2-hour period following intramuscular injection. The experimental results of this phase of the study are presented in Table 1.

Results: The 1-hour peak serum levels using 20,000 units of penicillin alone were in the 0.07 units per cc range. Two-hour serum levels, however, were ineffective. Using the low salt and fluid diet plus benzoic acid 1-hour levels were 0.56 units per cc and 2-hour levels 0.28 units per cc. A fall from 56 to 22 per cent. in the 2-hour urine excretion of penicillin as a result of diet and benzoic acid treatment reflects a similar trend (Chart 1). This represents an eight-fold increase in, as well as a prolongation of, the penicillin blood level. In the work with adrenalin⁶ using two and one-half times the dose of penicillin, the 2-hour levels were one fourth this amount, except for one case which showed the same level. With repeated injections every 2 to 3 hours, restriction of salt and water intake and administration of benzoic acid every 4 hours, the minimum levels obtained were 0.14–0.28 units per cc of serum. This

is a five to ten-fold increase over the levels usually maintained when two to five times greater doses of penicillin are used. This method of treatment is being applied to penicillin therapy in acute, subacute and chronic conditions, and will be discussed elsewhere.

Summary: (1) Restriction of fluid intake to 1,500 cc and the salt intake to 3 gm a day doubles the penicillin blood level following interrupted intramuscular

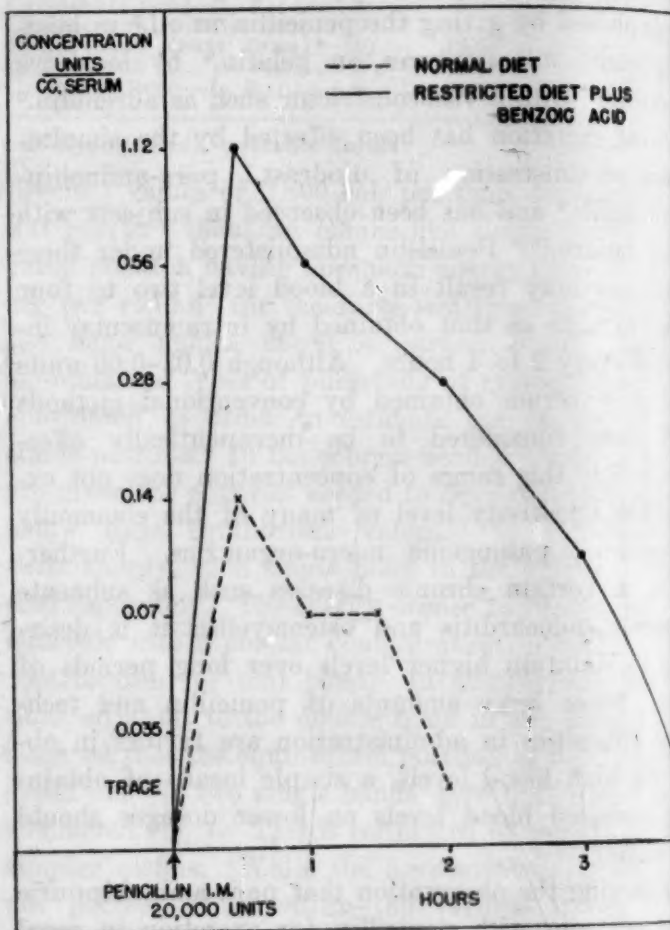


CHART 1

injections of penicillin. (2) The administration of benzoic acid to a patient on an unrestricted diet may double the penicillin blood level during similar treatment. (3) The combination of these two procedures results in a four- to eight-fold increase in penicillin blood level with a prolonged effective blood concentration.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE MICROBIOLOGICAL DETERMINATION OF CHOLINE¹

HOROWITZ and Beadle² have reported a microbiological method for the determination of choline, based

¹⁴ Sir A. Fleming, M. Y. Young, J. Suchet and A. J. E. Rowe, *Lancet*, 2: 621, 1944.

¹ Received for publication, April 11, 1945.

² N. H. Horowitz and G. W. Beadle, *Jour. Biol. Chem.*, 150: 325, 1943.

upon the growth response of *cholineless*, a mutant *Neurospora crassa*. The procedure calls for pressing out on filter paper the mold mat obtained at the end of the incubation period, and drying the material to constant weight. The dry weights are reported to vary from 2 to 50 mg for choline concentrations 0.5 to 20 meg in 25 ml of media.

In our hands the above procedure gave erratic

sults in tests of pure solutions of choline and of hydrolyzed extracts of biological materials before and after adsorption on and elution from permutit. Drying the mold mats on tared filter papers (Whatman, No. 50, diameter 11 cm) proved to be unsatisfactory since the papers showed losses in weight varying from 2 to 8 mg as a result of the filtration and washing operations. Furthermore, because of the time-consuming nature of these operations, the washings were inadequate. The medium contains approximately 28 mg of soluble solids per ml and the wet mold varies in moisture content from 90 to 95 per cent. so that failure to remove extraneous solids can account for variability in the weight of the small quantities of dried mold. Drying the mold in moisture dishes also gave erratic results, ± 20 per cent., since other than heavy mats could not be removed quantitatively from the filter paper and the dry material contained variable amounts of solids derived from the medium.

By the simple expedient of using fritted glass filters (30 ml capacity) of medium porosity, quantitative removal and washing of the mold growth is easily effected. The glass filters need be tared only occasionally, since the dry weights vary no more than ± 0.2 mg. Filtrations and washings are rapid since suction is employed. The mold suspensions may be stirred with a glass rod, thereby rendering the washings more effective. The relation between the dry weight of the mold and choline concentration is now consistently linear. The weight of dry mold for a given choline concentration is reproducible within ± 2 per cent. Tests on biological materials (yeast preparations, poultry feeds, pharmaceuticals, etc.) give good agreement among different assay levels.

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A QUICK TEST FOR FLOUR ENRICHMENT

ENRICHED flour under U. S. Government requirements must contain from 2.0 to 2.5 milligrams of thiamine, from 1.2 to 1.5 milligrams of riboflavin, from 13.0 to 16.5 milligrams of iron, and from 16.0 to 20.0 milligrams of niacin or its amide per pound of flour. Thiamine in flour is ordinarily determined by the thiochrome fluorometric procedure,^{1,2} or microbiologically;³ riboflavin, either fluorometrically⁴ or microbiologically;⁵ niacin, colorimetrically⁶ or micro-

biologically;⁷ and iron is ordinarily determined colorimetrically.⁸ The time-consuming nature of all these tests strictly limits the practicability of applying such tests in the routine inspection of flour.

The colorimetric niacin determination is based on the König reaction⁹ in which pyridine compounds react with cyanogen bromide and primary or secondary amines to produce complex colored compounds. The new rapid test described herein is based on the above reaction and, although not strictly quantitative, may be used to determine almost instantaneously whether a sample of flour is unenriched, partly enriched or fully enriched in respect to niacin (or its amide). The test requires the use of only two reagents: namely, a 4 per cent. aniline solution in ethyl alcohol and a 4 per cent. aqueous cyanogen bromide solution.

To make the rapid niacin test, place on white blotting paper or in the well of a porcelain indicator block about $\frac{1}{2}$ to 1 gm of flour. Press the flour flat with a spatula so that the packed flour is about 3 mm thick. Drop 2 drops of the aniline solution onto the center of the flattened flour, thus causing a wetted portion about 6 mm in diameter. Drop onto this wetted portion 3 drops of the cyanogen bromide solution. Almost immediately a canary yellow color appears, the depth of color depending on the amount of niacin present in the flour. A simple comparison with flour having known amounts of niacin treated the same way will give a roughly quantitative test. This color comparison should be made 4 minutes after the addition of the reagents. Unenriched flour will develop a slightly yellow color only after 10 to 15 minutes, probably because the small amount of niacin naturally present in unenriched flour is chemically bound in some manner and is gradually liberated by the reagents used. Enriched flour, however, contains a relatively large amount of niacin (or its amide) which is in the free state because it has been added as such in the enriching process.

Since flour is ordinarily enriched by the addition of an enrichment "premix" containing the various enrichment ingredients in the proper proportions, a test for any one of these ingredients in flour usually indicates whether or not the flour is fully enriched. The actual degree of enrichment can be determined, of course, only by actual assay for all four enrichment ingredients. In the routine inspection of flour the rapid niacin test should prove to be very useful

¹ R. T. Conner and G. J. Straub, *Indust. and Eng. Chem., Anal. Ed.*, 13: 380, 1941.

² A. Hoffer, A. W. Alcock and W. F. Geddes, *Cereal Chem.*, 20: 717, 1943.

³ A. S. Shultz, L. Atkin and C. N. Frey, *Indust. and Eng. Chem., Anal. Ed.*, 14: 35, 1942.

⁴ J. S. Andrews, *Cereal Chem.*, 20: 613, 1943.

⁵ F. M. Strong and L. E. Carpenter, *Indust. and Eng. Chem., Anal. Ed.* 14: 909, 1942.

⁶ E. Hausman, L. Rosner and H. J. Cannon, *Cereal Chem.* 20: 82, 1943.

⁷ W. A. Krehl, F. M. Strong and C. A. Elvehjem, *Indust. and Eng. Chem., Anal. Ed.*, 15: 471, 1943.

⁸ J. B. Thompson, *Indust. and Eng. Chem., Anal. Ed.*, 16: 646, 1944.

⁹ W. König, *J. prakt. Chem.*, 69: 105, 1904; 70: 19, 1904.

in detecting immediately any lots of flour that are unenriched in respect to niacin as well as in segregating for more precise testing those lots in which the enrichment is of doubtful adequacy.

The rapid niacin test can also be used in a similar

manner to distinguish enriched from unenriched white bread.

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DISCUSSION

ROTATING ACTION ON MATTER IN A BEAM OF LIGHT¹

REFERRING to the paper read by me on January 19, 1945, at the New York meeting of the American Physical Society, G. F. Hull has clearly understood that my claims are new, as he says "that he (Ehrenhaft) had claimed to prove that a beam of natural (unpolarized) light produces a rotating action on matter," while, as Hull states later on according to his text-book, "the rotating action in a beam of circularly polarized light is exceedingly small, and in a beam of natural light nothing whatever."

When Lebedew² and Nichols and Hull³ worked, forces only down to 10^{-5} or 10^{-6} dyne could be measured.⁴ In 1909 I developed a method of measurement of forces exerted on single microscopic or sub-microscopic bodies which enable the measurement of forces as small as 10^{-10} dyne and applied it for the determination of the size and the electric charge of single spherical particles of well-known density.⁵ This method was next used by K. Przibram⁶ in the measurement of the electric charge on single droplets of mist and later by others on oil drops. This method, 10^4 times more sensitive than former methods, has resulted in the detection of phenomena concerning the interaction between radiation and matter which I termed "Photophoresis."⁷ In a concentrated beam of natural light, test bodies of the same size and with the same physical properties move simultaneously with the direction of propagation of the radiation (light

positive) and against this direction (light negative). Radiometer forces of the Crookes type or similar effects can not be accountable for the observed facts.^{8,9}

The above movements can be influenced by the superposition of homogeneous magnetic or electric fields (magnetophotophoresis, electrophotophoresis). Particles irradiated by light do move in the homogeneous magnetic field and reverse their direction of movement with the reversal of the field as often as desired. It must be concluded that they carry an excess of north or south magnetic charge. Many of the test bodies exhibiting a magnetic charge in the light retain this charge in the dark and continue their movement in the dark.¹⁰ Thus, expanding the terminology of Faraday, there exists a magnetic ion in general and consequently a magnetic current. The electric action of magnetic currents, the counterpart of the magnetic action of electric currents has been demonstrated.¹¹ This means that the single electric charge (pole) rotates around the magnetic current and that the single magnetic charge (pole) rotates around the electric current (Oersted-Ampere).

In my recent measurements of single magnetic charges on microscopic particles, I separated the influence of light from the influence of the magnetic field by measuring these charges in the dark.¹² I further investigated again the ponderomotive force of light upon matter. If one introduces and allows to fall into a vertically projected beam particles of, for instance, Cr, Fe, Mn, Cu_2O , those of a size of about the wave-length of light and smaller fall vertically, while those of more than wave-length of light in size describe in falling distinct helical paths in the beam of light, as already observed by me and my school in Vienna and Whytlaw-Gray (Leeds)⁸ in the horizontal beam. Whytlaw-Gray has repeated my experiments and obtained identical results.

⁸ R. Whytlaw-Gray and H. S. Patterson; "Smoke, a Study of Aerial Disperse Systems." London: Edward Arnold and Company, 1932. P. 126; *Leeds Phil. Lit. Science*, Sect. 1, 70, 1926.

⁹ F. Ehrenhaft, *Jour. Frank. Inst.*, 233: 239, 1942.

¹⁰ F. Ehrenhaft and Leo Banet, *SCIENCE*, 96: 228, 1942.

¹¹ F. Ehrenhaft, *Nature*, 154: 426, 1944; *Phys. Rev.*, 65: 287, 1944.

¹² F. Ehrenhaft, *Bull. Am. Phys. Soc.* (New York Meeting) 6; 1945. See H. S. Renne, *Radio Electronic Engineering* (*Radio News*), 4: 22, 1945.

¹ Comment on Gordon Ferrie Hull's article "The Torque or Rotating Action in a Beam of Light," *SCIENCE*, 101: 220, 1945.

² P. Lebedew, *Astr. Ges. St. Petersburg*, 37: 220, 1902.

³ E. F. Nichols and G. F. Hull, *Ann. der Phys.*, 12: 223, 1903; F. Ehrenhaft, *Ann. der Phys.*, 56: 103, 1918; *Ann. de Phys.*, 13: 171, 1940.

⁴ D. K. Konstantinowsky, *Physik. Ztschr.*, 21: 698, 1920.

⁵ F. Ehrenhaft, *Wiener Akad. Anz.* VII, March 4, 1909; X, April 21, 1910; *Wiener Berichte*, 119: 815, 1910; *Physik. Ztschr.*, 11: 619, 1910, etc., *Physik. Ztschr.*, 39: 673, 1938; *Philosophy of Science*, N.Y.C., 8: July 3, 1941. "The Microcoulomb Experiment, Charges smaller than the Electronic Charge."

⁶ K. Przibram, *Physik. Ztschr.*, 11: 630, 1910.

⁷ F. Ehrenhaft, *Ann. der Physik.*, 56: 81, 1918; *Comp. Rend.*, 190: 263, 1930; see literature about photophoresis: *Ann. de Physique*, 13: 151, 1940; *Jour. Frank. Inst.*, 233: 235, 1942.

In my recent experiments made with Richard Whitall it was determined that often the bodies made five to ten revolutions per second around the axis of the helix, and the radius of this helical path is exceedingly large compared with the radius of the body. These facts can be easily understood. Optically active substances rotate the plane of polarization of light, and Faraday (1845), despite the scepticism of his contemporaries, succeeded in rotating the plane of polarization by applying a magnetic field parallel to the beam.

The helical paths have been observed with linear polarized light as well as with natural light, with and without parallel external magnetic field. This is to be expected, since the light scattered by a spherical body is for the most part linear polarized, and since our magnetophotophoresis experiments demonstrate that in the direction of the light beam there exists a static longitudinal magnetic field analogous to the electrostatic field therein predicted by Woldemar Voigt.¹³ These fields can explain in some respect electro- and magnetophotophoresis with the movement of electrically charged bodies in the longitudinal electric field or magnetically charged bodies in the longitudinal magnetic field of the beam of light. Concerning the helical movement in the beam of light, the electric charge rotates around the longitudinal magnetic field and *vice versa*.

The helical movement of particles observed by me and Whytlaw-Gray can not be explained by the formulation of Maxwell-Poynting, on which point of view G. F. Hull has based his work on light pressure.

It has been found that light rotates matter, if matter is free to move with three degrees of freedom. The well-known principles of conservation of linear and angular momentum of electrodynamics (Poincare, Max Abraham) do not cover the experimental facts that light can exert forces of attraction, repulsion and torsion. Regarding the general theoretical conclusions it is evident that we have to add to the electrodynamic equations the expression for the true single magnetic charge and therefore the term for the magnetic current.¹⁴ The formulations have to be broadened in such a way as to include the three actions listed above.

These observed actions require a modification of the relation $E = mc^2$, pronounced for the first time by Hasenoechl (1904) for the radiation of black bodies,¹⁵ generalized later on, as well as a revision of the more modern concepts which have been derived from the

enunciation of A. Soldner (1801), entitled "About the Deflection of a Beam of Light from its Rectilinear Movement through the Attraction of a Celestial Body Near Which the Beam Passes."¹⁶ In considering astrophysical questions it is clear that one must take into account not only the repulsive force of radiation but also the attractive and rotational forces.

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COLCHICINE AS A GROWTH STIMULATOR¹

In a recent paper, Loo and Tang² reported that colchicine in relatively low concentrations (10^{-5} M to 10^{-6} M) accelerated the germination of seeds of mungo bean, maize, cabbage, rice and wheat, but the treating of seeds for twelve hours at these concentrations was deleterious to subsequent early growth. Patton and Nebel³ had previously observed that colchicine in a concentration of 10^{-4} M seemed to stimulate respiration slightly.

That colchicine or any toxic substance should act as a metabolic stimulant in very dilute concentrations is not surprising, but our observations on the results of the use of colchicine on seedling trees indicate that colchicine in effective concentrations short of that necessary for the production of polyploid cells does stimulate growth in some plants.

In the spring of 1944, more than twenty species and hybrids of tree seedlings were treated with a 0.4 per cent. solution of colchicine emulsion which included a wetting agent. The trees were treated by pipetting one drop per day on each apical meristem for four to, in some instances, twenty days. The usual cessation of apical growth and subsequent hypertrophy with some killing occurred, but in sixteen seedlings of four species of *Quercus*, two species and one hybrid of *Castanea* and three hybrids of *Corylus*, there followed marked increase of the rate and total length of apical growth. The order of increase was slightly more than double the best growth of the untreated controls. Allowing for differences in genetic and possibly environmental factors, the evidence seems to indicate that the increase in rate and total length of growth was due to the action of colchicine.

Whether the increase in growth was due to the direct stimulation of cellular metabolism or produced

¹⁶ A. Soldner, Bode's Astronom. Jahrbuch, 161-172, 1804.

¹ This work was part of a program in forest genetics supported by a grant from the General Education Board.

² T. Loo and Y. Tang, *Am. Jour. Bot.*, 32: 106-114, 1945.

³ R. L. Patton and B. R. Nebel, *Am. Jour. Bot.*, 27: 609-613, 1940.

¹³ Woldemar Voigt, Festschrift fuer Heinrich Weber, 1912.

¹⁴ Oliver Heaviside, "Electromagnetic Theory," 1, 25, 1893.

¹⁵ R. Hasenoechl, *Ann. der Physik.*, 15: 344, 1904; 16: 589, 1905.

by the initial inhibition of growth by the colchicine, thus permitting the accumulation of metabolic reserves in the meristems, which, released by the disappearance or reduction in effective concentration of the colchicine by the cessation of treatment resulting in a belated but greatly increased rate of growth, is not known.

All the plants which responded by increased growth to colchicine applications were those treated with four to seven applications of the 0.4 per cent. solution.

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TOADS IN THE MARIANAS

ON October 23, 1944, the junior author took advantage of a brief shore leave to explore the ruins of the town of Tenian on the Island of Tinian. He observed large numbers of toads and tadpoles in cisterns and numerous lily ponds of the former Japanese settlement. No exact counts were made, but a rough estimate of at least 12 adult toads in each of over 100 cisterns plus at least twice that number for the lily ponds yields a population of close to 4,000 adult toads at that time. Because the junior author was not certain that this was a species of toad desired by the senior author, he collected only 4 animals, two of each sex. On the voyage back to the United States one male was lost; it jumped overboard. The remaining three animals were utilized for several purposes, after their safe arrival. Blood smears were made and the intestines were used for the study of the intestinal fauna; testes and potential ovaries (Bidder's organs) of the surviving male were fixed for cytological study.

It appeared that the toads were typical specimens of *Bufo marinus* Linnaeus, an assumption which was confirmed by Arthur Loveridge, of the Museum of Comparative Zoology. One female is incorporated in the collection of the Museum of Comparative Zoology, while the other female and the male are deposited in the Museum of Vertebrate Zoology at the University of California under the numbers 40856 and 40857.

No records have been found of the occurrence of toads in the Mariana Islands; and while the introduction of *Bufo marinus* into the Hawaiian, Solomon and Fiji Islands was known, the newest record would add to the list of introductions. The observation of such large numbers even after the shelling of the town would indicate that the introduction resulted in a successful establishing of the species.

R. STOHLER

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ALBERT G. COOLING
Third Mate, U. S. M. M.

BOTANISTS SOMETIMES IMPORTANT MILITARY TACTICIANS

MANY people look upon the average botanist as a rather theoretical and prosaic individual, whose talents are best spent in the quiet fields back of the lines rather than in the field of tactics of an active war front. This may be generally true, but one great English botanist, John Ball,^{1,2} by his detailed knowledge of geographical botany in the Alps, pointed the way to victory for the Italian army fighting against Austria in 1866. Garibaldi was at that time feeding the Italian soldiers to the Austrian gunners in the Austrian fort of Val Ampola, near Lago di Ledro. John Ball, thoroughly familiar with the Alps from his long botanical studies and explorations of this region, gave the Italian War Office such valuable information that it soon led to the capture of this fort. For this timely advice the Italian staff decorated him.

John Ball was a most remarkable personality, as well as a distinguished botanist of the old school. He was a keen scientific philosopher, and an observant and discriminating naturalist, as his "Notes of a Naturalist in South America," published in 1887, attest. The style and interest of this work makes it a classic in its sphere.

It is of interest that Ball organized the Palliser Expedition to discover the best route across the Rocky Mountains of British America, and of the 4 passes first surveyed one, Kicking Horse, was used by the Canadian Pacific Railway.

It falls to the lot of few botanists to be as versatile and to become as distinguished in so many fields as John Ball. In spite of his varied accomplishments he complained that his fondness for society prevented his giving much time to scientific work.

H. A. ALLARD

WASHINGTON, D. C.

THE "U. S. BOTANICAL GARDEN" AGAIN

IN 1934 the director of the so-called U. S. Botanical Garden retired. Then the Honorable Kent Keller, Congressman from Illinois, chairman of the House Library Committee (which with the Senate Library Committee had jurisdiction over the institution), realizing the sad condition of the place and its worse reputation, strove to raise its standards. He sent questionnaires to every known botanical garden of the world, and sent Professor F. A. Varrelman, then at the American University in Washington, to Europe to inspect, photograph and gather information from

¹ Obituary by Sir Joseph D. Hooker. 16 pages. 1890. A reprint from the *Jour. Roy. Geog. Soc.*

² John Ball, F.R.S., by W. T. Thistleton Dyer. *The Jour. of Bot.*, 27: 365-370. 1889.

very botanical garden there. A wonderful report was compiled, submitted to Mr. Barkley, but it was never published, and no one to-day knows where it is.

At that time, Professor H. H. Bartlett, of Michigan, represented the botanists in a committee striving to separate the "Botanical Garden" from the Congress, that it might function as a scientific institution. Y. Morrison represented the Department of Agriculture, which also tried to gain control, both futilely. Mr. Barkley appointed David Lynn, the Capital Architect, as acting director. This made Wm. Pagett, assistant director, the functional director, and the conditions went on in the same unscientific way.

On February 1 Mr. Pagett retired. Through the aid of scientists in states whose senators and representatives were on the library committees, more than a majority of such members were pledged to have a scientific made functional director. None was consulted. Mr. Lynn promoted a German gardener, Mr. Sauberer,

to be assistant director. It still works without scientific guidance.

MARIUS VAN REMLAR

FULL EMPLOYMENT AFTER THE WAR

A CORRESPONDENT has indicated to me privately that my recent discussion regarding achieving full employment after the war¹ carried an implication that government-sponsored research should be frowned upon. This was inadvertent and far from my thought. I did intend to emphasize the desirability "that a substantial amount of investigation should remain in private hands" and that if research were sponsored by the government alone it would be in danger of becoming sterile. There is no doubt that much government-sponsored research has been tremendously valuable.

ROGER J. WILLIAMS

THE UNIVERSITY OF TEXAS

SCIENTIFIC BOOKS

SCIENCE IN PROGRESS

Science in Progress. Fourth Series. 1945. Yale University Press. xvi + 331 pp. \$3.00.

This book consists of eleven "Sigma Xi lectures" of a great diversity of scientific topics. All but one were delivered before numerous chapters of Sigma Xi traveling lecturers; the exception is the 1944 "Annual Sigma Xi lecture" of the general meeting at Cleveland in September of that year. Presumably before they were designed for audiences consisting of the main of scientists, yet not of specialists in their respective fields. I will try to assess them primarily though not entirely from the standpoint of an audience, though their great diversity in length suggests that some at least have been rewritten.

As the ideal lecture I commend that of Selig Hecht, titled "Energy and Vision" and dealing, as its author says, "with the simple question: How much energy do we need to see light?" As the outcome of very ingenious and very delicate experiments it is found that an astonishingly small number of 5 photons absorbed by the retinal rods is enough to produce the sensation of a flash in the dark-adapted eye. I can not imagine the presentation could have been bettered, and I congratulate the audiences which heard it. Near the end Hecht inquires: If five photons suffice, why not one? The answer, if I paraphrase it correctly, is: Only one were sufficient the brain would often be misled by a single nerve impulse arising "fortuitously," so it waits for attestation by five nerves before accepting the testimony. Very clever of the

I. I. Rabi, in what is unfortunately the shortest paper of all, has contributed an extremely condensed and congested account of his method of "radiofrequency spectroscopy" for detecting the precession of molecules in magnetic fields and providing the grounds for inferences about the parts of these molecules. All physicists and many others can guess why the author's time was too scant to permit of more, and I can only assure the non-physicists that it was bad luck for them.

P. Debye treats of the art of "magnetic cooling," which leads to temperatures by far the lowest ever reached, and of which he was one of the two independent inventors. This is a difficult matter to expound, as the reviewer well knows. Debye draws the analogy between isothermal compression and adiabatic expansion of an ideal gas on the one hand, and isothermal magnetization and adiabatic demagnetization of a paramagnetic medium on the other. This has the disadvantage that the "work" which appears in the latter case is far from easy to grasp, and the advantage of avoiding the tricky concepts of entropy and order. But having gained this advantage Debye promptly tosses it away, and the lecture proceeds to a study of the entropy of trivalent iron ion, in which I fear that the non-physicists of the audiences got lost.

H. Eyring speaks of the detailed history of chemical reactions as interpreted by modern statistical theory: his title is "The Drift toward Equilibrium." At the beginning his style is fluent, graceful and witty, and the audiences must have been delighted. The description of a chain-reaction is humorous and vivid,

¹ SCIENCE, 101: 537, 1945.

but it does not soften up the fundamental postulate of statistical mechanics as stated with ruthless rigor three pages further on: and when after another three pages the reader confronts the (undefined) "barrier" I suspect that he will be stopped, and this at least will save him from being burned by the (undefined) "hot molecules" and then going astray in the (undefined) "configuration-space" which he is invited to enter. Forgive me, Professor Eyring! I do not intend to imply that there is anything wrong with your fabric, but just that it is tailored for minds already molded by long study of thermodynamics and statistical physics. For such minds it is well adapted and (to depart from the metaphor) concentrated but instructive.

O. Loewi spoke under the title "Chemical Transmission of Nerve Impulses." This illustrates strikingly how the verbal usages of one science may confuse the practitioners of another. To the physicist or engineer, this title implies the passage of impulses along a nerve; but what Loewi means is what the physicist would call the "coupling" of a nerve to a muscle. This coupling or transmission is managed by a chemical substance which the nerve-ending releases and which stirs the muscle to action. With the biological meaning of "transmission" clear in mind, and with a little more knowledge of the terminology of the nervous system than the reviewer possesses, the reader should find this lecture suitably clear and notably interesting.

D. W. Bronk presents a highly readable account of "The Physical Structure and Biological Action of Nerve Cells." To a small group of physicists and engineers, part of what he says can be condensed into the phrase that the nervous system is a truly wonderful servomechanism. The electrical phenomena in calls have been studied with the aid of physical apparatus of the utmost refinement, and the story ought to stimulate some physicists to dedicate themselves to biophysics. The lecture also treats some of the physiological problems pertaining to aviation; and these in part, but the psychological problems mainly, are the topic of the longest paper in the book: "Psychological Aspects of Military Aviation," by W. R. Miles. This is packed with information about such matters as the tests applied to prospective fliers—too packed, indeed, for easy reading.

K. C. D. Hickman writes, under the title "Adventures in Vacuum Chemistry," on the recent advances in the art of distillation and the application thereof to the Vitamin A industry. The audiences may have been swamped by the flood of information ranging from physics through chemistry to biology, but the material is well presented. I think that it must be a slip (on page 212) which implies that a tea-kettle produces a vacuum of 10^{-3} mm Hg, and I do not fol-

low the explanation (on page 223) of the persistence of the spiral pattern. The "Present Status of the Vitamin B Complex," as described by C. A. Elvehjem is apparently that the said system is found to consist of a good many things (some of them having chemical formulae so complicated it seems a wonder that they are known) of which the properties are found largely by observing what happens to an animal which does not get them in its diet. Happy the experimental physicist who works with spectroscopes and electronic devices on nice clean inorganic matter!

E. J. Cohn's admirable "Blood and Blood Derivatives" is the 1944 Sigma Xi lecture. It is thrilling to read of the complicated nature of the blood and its exquisite adaptation to so many purposes; thrilling also to hear of the skilful ways of separating and conserving its constituents for the benefit of the injured and the sick, one of the few offsets to the horrible expense and irrevocable waste of war. Osmotic pressure proves, as usual, difficult to present; we find the strangely sounding statement that "molecules by exerting osmotic pressure pull water back into the bloodstream."

The brilliant mathematician, George Birkhoff, whose sudden death is so much deplored, contributed a lecture, "The Mathematical Nature of Physical Theories." I am sorry to be obliged to conclude that he lost his audiences, excepting the mathematicians and a few mathematical physicists, in a very few minutes. Several times he refers too sketchily to little known work of his own. It is tantalizing, for instance, to read that "the form of relativity of motion appearing in (Einstein's) theory is really that which would be suggested naturally to an astronomer who looked out upon the stellar universe with a completely impartial view" and then be sent elsewhere for explanation!

KARL K. DARROW

BOOKS RECEIVED

- Annual Review of Physiology.* Vol. VI. Pp. 630. Annual Reviews, Inc. \$5.00. 1945.
- CANNON, WALTER B. *The Way of an Investigator: Scientist's Experiences in Medical Research.* Pp. 2. \$3.00. 1945.
- CARTER, G. W. *The Simple Calculation of Electrical Transients.* Pp. viii + 120. Illustrated. Cambridge University Press, The Macmillan Company. \$1. 1945.
- CLIFFORD, HARRY E., and others. *Transmission Lines, Antennas and Wave Guides.* Illustrated. Pp. xv + 3. McGraw-Hill Book Company. \$3.50. 1945.
- DIEHL, HAROLD S. *Textbook of Healthful Living.* The 4th edition. Illustrated. Pp. xiii + 707. McGraw-Hill Book Company. \$2.50. 1945.
- KEYS, THOMAS E. *The History of Surgical Anesthesia.* Illustrated. Pp. xxx + 191. Schuman's, New York. \$6.00. 1945.

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SCIENTIFIC SOCIETIES IN THE UNITED STATES

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SCIENCE NEWS

Science Service, Washington, D. C.

TOTAL WAR AGAINST INSECT PESTS

TOTAL war against man's insect enemies, with the avowed object of total extermination instead of mere "control," was offered as a possible and practicable program before the New York meeting of the American Association of Economic Entomologists, in the address of its retiring president, Professor E. O. Essig, of the University of California. Man has unintentionally wiped out a number of animal species, like the dodo and the passenger pigeon; there seems to be no good reason why he should not be able to repeat the performance intentionally with other species he finds obnoxious, if he will only plan carefully enough and follow through with sufficiently long and intensive campaigns of eradication.

Success in at least one such campaign was cited by Professor Essig. About twenty years ago the Mediterranean fruit fly, a terrible menace to certain fruit and vegetable crops, especially the citrus fruits, was accidentally introduced into Florida. Drastic measures were necessary, but by thorough cooperation among federal, state and private interests the last traces of the fly infestation were wiped out in a short time.

Similar success appears to be in sight in campaigns now being waged against other insect pests. Among these, Professor Essig mentioned the Mexican fruit fly, pink bollworm and sweet-potato weevil in the South, and the pear psylla in the Pacific Northwest. Prospective victims suggested by the speaker for future anti-insect blitzes include Japanese beetle, gypsy moth, browntail moth, all kinds of malaria mosquitoes, bedbugs, lice, fleas and houseflies.

A powerful agent in these postwar wars to make crops less costly and personal life safer and more comfortable is the now known DDT. At the meeting, the first official pronouncement of organized entomological science on this insecticide was offered, in the form of a special committee report.

DDT has tremendous possibilities, the report emphasized; but there are also some difficulties attending its use that need further investigation without loss of time. For this reason, adequate funds and personnel for research were pointed out as desirable, together with the assignment of sufficient quantities of DDT for experimental purposes.

DDT's promise spreads broadly over three fields: public health, household comfort and agriculture. In the first category come the triumphs already scored by DDT against such plagues as malaria and typhus. Household comfort will be promoted by the abatement or even the complete wiping out of such insects as flies, fleas, bedbugs and "nuisance" mosquitoes. DDT can be useful to agriculture not only in combating field and orchard insects, but also in protecting forests, livestock and poultry.

DDT is poisonous to man and the warm-blooded animals generally if swallowed in sufficient quantity, or absorbed through oil on the skin. However, as commonly used at present, there seems to be an adequate margin of safety.

Cold-blooded animals, like fish and frogs, and beneficial insects are more sensitive; their protection was cited as one of the desirable objectives of research.

ITEMS

SOVIET blood will soon be prepared for fighting shock in Russian wounded through use of four complete plasma processing units given to the U.S.S.R. Red Cross and Red Crescent Societies by the American counterpart of this organization, the American Red Cross. Professor Peter G. Strelkov, of the U.S.S.R. Academy of Sciences, flew to this country to arrange for its use in Russia, and Captain John Reichel, Jr., of the Office of the Surgeon General of the U. S. Army, will accompany the apparatus to Russia to aid in its installation and use. Professor Vladimir Lebedenko, Washington representative of the Soviet Red Cross, in receiving the apparatus in presentation ceremonies stated that the 4,000 pints of blood daily that will be processed by the four units will supply the Russian armies and civilians in reoccupied areas as well. The equipment was paid for from war relief funds given the Red Cross by Congress.

THAT the post-war personal airplane may become as easy to fly as it is to tune a push-button radio, is predicted by Oliver L. Parks, president of Parks Air College, at East St. Louis, Ill. Progress in the design and development of airplanes and electronic devices will make this easy flying possible. In the future it is entirely possible that a pilot will be able to take his plane off the ground, bring it to the desired altitude, set its nose in the proper direction, and by push-button controls, tune it into a beam directed at the city of destination. With the aid of an automatic pilot the plane would fly on the beam. Such a device would not have to be expensive, according to Mr. Parks, since the price of automatic pilot devices has gone down by several hundred per cent. during the war.

GAS turbines in railroad locomotives may be widely used in the future. Investigations show that they have sufficient natural advantages to assure them a place of recognition for such use, was reported by J. T. Rettaliata, of the Allis-Chalmers Manufacturing Company, at the New York meeting of the American Society of Mechanical Engineers. The speaker gave details of a 4,800 horsepower electric-drive locomotive, powered by two gas-turbine units. Its top speed when hauling 15 cars weighing 1,000 tons is 95 miles per hour on a tangent level track. Its maximum speed with a single engine in operation, he said, would be approximately 70 miles per hour. Operation of the locomotive is economical. "The absence of water in the cycle is a natural advantage for railroad service. The low maintenance record associated with the oil refinery gas-turbines of similar design encourages the present contemplation that the service charges on locomotive units will be correspondingly moderate. As is characteristic with all equipment of the turbine type, lubrication costs should be exceedingly small; it is estimated that they will be less than one per cent. of the fuel costs."

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*Professor of Electrical Engineering and Chairman of General Science
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To be published January 30th. \$2.75 (probable)

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SCIENCE NEWS

Science Service, Washington, D. C.

THE NATIONAL NETWORK FOR TELEVISION

PLANS for an expanding nation-wide network of coaxial cables, which may be supplemented by radio relay systems for carrying both television pictures and telephone conversations, were reported recently by Harold S. Osborne, chief engineer of the American Telephone and Telegraph Company.

He pointed out that the coaxial cable system has been successfully tested for distances up to 800 miles, and that the radio relay system is now under development. A continually expanding program of construction has been undertaken in which these systems will link cities up and down the Eastern Seaboard, across the continent and from the east to Chicago, St. Louis and intermediate points.

Mr. Osborne stated that "A fundamental feature of the coaxial cable system from the standpoint of economics is that the cable is its own power transmission line. Another method of providing long distance television transmission which looks promising is the radio relay system. Approval of the Federal Communications Commission has already been obtained for . . . a development trial of such a system between New York and Boston, and work will proceed as soon as relaxation of war demands makes this possible."

If radio beams are found to have undesirable characteristics a super-high frequency system using wave guides may be employed. These wave guides are simply hollow pipes which serve to isolate a little section of space and thus guide the transmission of very high frequency waves, and also to protect them against interference. Such wave guides are now used extensively for short distances in ultra-high frequency work.

A comprehensive and highly trained maintenance force is necessary for the continued satisfactory operation of both systems. In the case of the coaxial cable system, the things to be maintained for a single television transmission circuit include terminal equipment at the ends, amplifier equipment and sources of power at intervals of 50 to 80 miles, simple amplifier equipment at intervals of about five miles without sources of power, and the cable itself throughout the entire distance. In the case of the radio relay system, terminal equipment at both ends and repeater stations with sources of power and antennae structures at intervals of 30 miles have to be kept in working order.

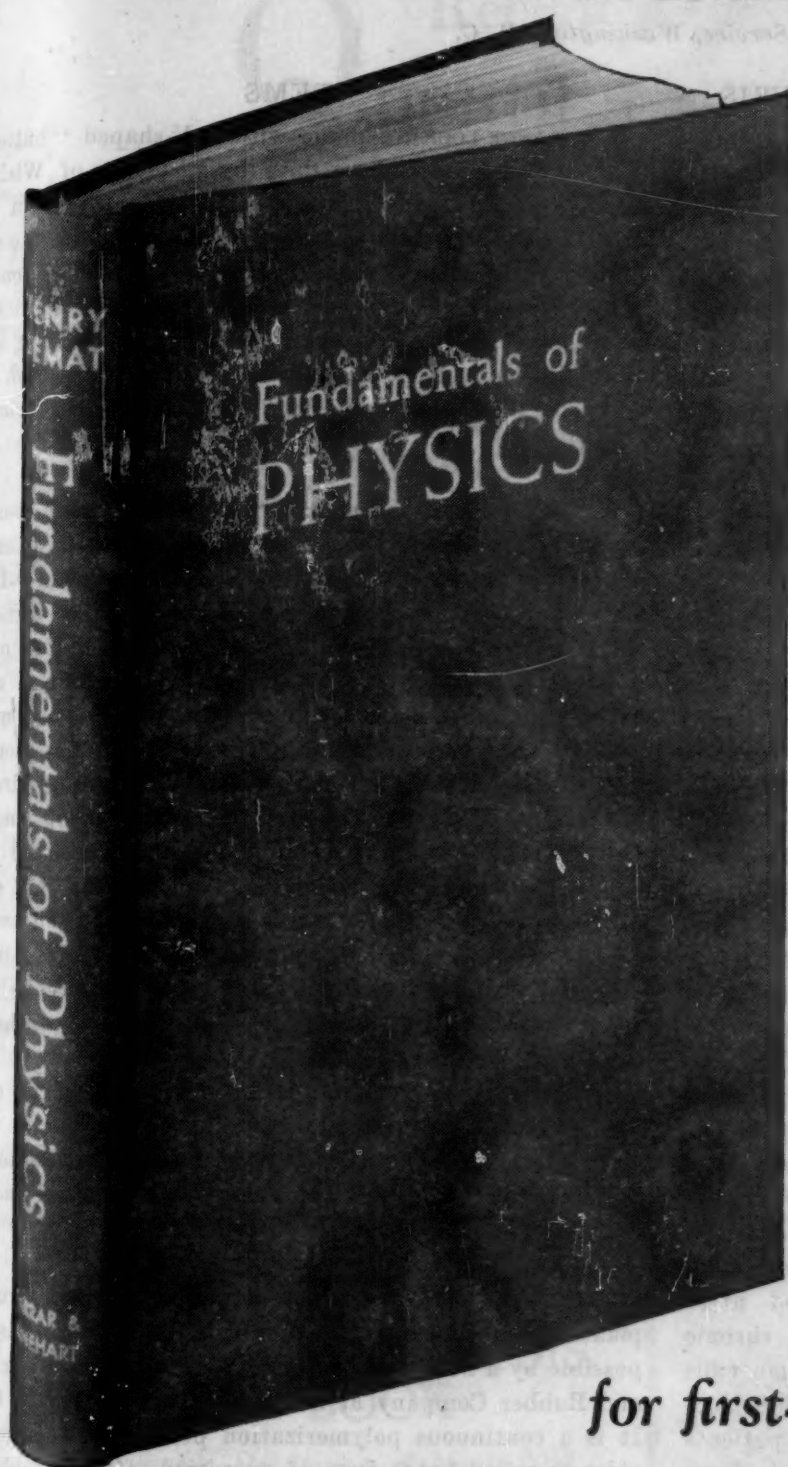
ITEMS

SCIENTISTS in the United States are collaborating with their Latin-American colleagues in making available files of journals for new and active institutions where the lack of adequate library facilities has greatly impeded research. Already the libraries of two such institutions have been assisted by the addition of journals. The

Committee on Inter-American Scientific Publications headed by Dr. Harlow Shapley, director of the Harvard Observatory, is now collecting journals for a number of other Latin-American institutions. Those who have unused files of journals which they are willing to contribute are invited to communicate with the Comite Interamericano de Publicación Científica, Harvard College Observatory, Cambridge 38, Mass.

DDT, synthetic chemistry's most potent weapon against insects, bids fair to become a regular ingredient of interior paints and wall finishes, as a means of automatically ridding houses of flies and other pests. Experiments indicating this as a practical possibility were reported in a communication to *Nature*, by two British paint chemists, G. A. Campbell and T. F. West. Tests were first made with wire-screen cages, in which were placed plywood panels that had been coated with an oil-bound water paint containing 5 per cent. of DDT. Flies confined in these cages were all killed. Repetitions of the test after two months showed that the DDT-laden paint was still lethal to flies. Further tests were made on a larger scale by painting the walls of small rooms with the same material, except that the mixture was more dilute, made only one-tenth as strong in DDT—0.5 per cent. instead of 5 per cent. Despite the greater dilution the DDT in the paint killed 90 per cent. of the flies that roosted on the walls and ceilings overnight. Hard finishes, like ordinary oil paints and synthetic varnishes have thus far not proven successful as carriers of DDT.

THAT more than a million new organic compounds may be produced in the future from petroleum and natural gas, was reported by Dr. Gustav Egloff, of the Universal Oil Products Corporation of Chicago, at a recent meeting of the Los Angeles section of the American Chemical Society. "Petroleum refining," he said, "is becoming more and more a chemical industry." Natural gas and petroleum are veritable treasure troves of paraffin, olefin, acetylene, cyclo-paraffin, cyclo-olefin, and aromatic hydrocarbons that open vast vistas in chemical research which have been only faintly explored. Individual compounds such as isopentane, isooctane, triptane, isobutylene, butadiene, toluene, and styrene, and chemical compounds such as phenols, cresols, organic acids, resins, plastic explosives, synthetic rubber, and many other derivatives are being produced from petroleum. Dr. Egloff stated that the industries based on the newer petroleum chemistry, involving aliphatic hydrocarbons as base materials, have infinitely greater possibilities than the industries based on coal tar chemistry, even though it is estimated that coal tar has served as a source of about 500,000 derivatives. Coal-tar hydrocarbons are mainly aromatic in character, and this limits the number of derivatives which can be produced from them.



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SCIENCE NEWS

Science Service, Washington, D. C.

MUSCLE FUNCTIONING IN PARALYSIS

ENCOURAGING results with a new treatment to restore muscle functioning in patients crippled by paralysis, rheumatoid arthritis and injury or infection are reported by Dr. Herman Kabat, of the U. S. Public Health Service, in the *Public Health Reports*.

An elderly woman confined for six years to bed and wheel chair because of rheumatoid arthritis was able after two weeks of treatment to stand up and walk. A man paralyzed on his right side for seventeen years was able, twenty-four hours after starting the treatment, for the first time in many years, to touch the top of his head, the opposite shoulder, the opposite buttock, his mouth, chin, put a cigarette in his mouth, lift his shoulder blade and move his hip. After one month of treatment he could stand up straight with both heels on the ground, both knees straight and only slight humping of his back.

The treatment that brought about these and similarly striking improvements in other patients, when other treatment had failed, consisted in injections under the skin once or twice a day of neostigmine. This synthetic chemical is also known as prostigmine. It has for some years been used successfully to relieve the fatigue and muscle weakness of myasthenia gravis.

Dr. Kabat and Dr. M. E. Knapp, of the Medical School of the University of Minnesota, in 1943 reported trying it in the treatment of infantile paralysis. They found it produced relaxation of muscle spasm, relief from pain, increase in strength and improvement in muscular coordination in the polio patients. This and other studies suggested to Dr. Kabat that it might prove effective in a variety of conditions in which failure of nerve and muscle functioning was causing crippling and disability.

So far he has tried it in fifty-three patients. Some had muscle spasm, contracture, joint weakness, pain and muscle weakness persisting for a long period after sprains, fractures and other injuries or after chronic infection. Some had hemiplegia, which the layman calls a paralytic stroke. Some had Bell's palsy. Others had facial paralysis. Included in the group were five patients with the spastic type of cerebral palsy. Rheumatoid arthritis and bursitis of the shoulder were the other conditions.

Dr. Kabat reports that "Improvement in range of motion, relief from pain and increase in strength and endurance may occur rapidly."

What percentage of patients suffering from these conditions can be helped by the neostigmine treatment can not be stated at present. Further study is needed to determine this. Patients in whom active inflammation, loss of innervation or bony or fibrous consolidation of a joint is the primary cause of the disability can not be expected to benefit from the treatment.

"The results have been encouraging enough to warrant further investigation," according to Dr. Kabat, who states that an evaluation of the treatment is now being made.

ITEMS

A STRANGE-LOOKING plane with a V-shaped "butterfly tail" is being seen these days by residents of Wichita, Kans., and nearby communities as it is taken on test flights. The new tail, a radical departure from the conventional inverted T-shaped tail, was installed on an AT-10 trainer plane to investigate the possibilities of simplified structure, the elimination or reduction of compressibility effects at high speeds, and the effect on stability, control, and handling ease, *American Aviation* reports.

A NEW device, known as a "sky-hook," will soon be dropping supplies of food, medicine and mail from cargo planes to military personnel in isolated spots. It is better for this use than a parachute, since in ordinary winds it will land almost directly beneath the point of release. Developed by the Matériel Command, Wright Field, the sky-hook drops to earth with the floating movement of the winged seed of the maple tree. The moment that the sky-hook is released it begins spinning directly towards earth without forward motion. Various models can drop loads ranging in weight from ounces up to a hundred pounds. The heavier the load, the faster it spins as it drops to the ground. Sky-hooks are made in several models of steel, aluminum and plastics. They look like a woman's large hat box with a wing stuck on one side. They are about 10 inches thick and 18 to 20 inches in diameter. The cargo container is circular in shape with a slightly rounded bottom. It has a capacity of 2.5 cubic feet, or about 17 gallons. Each sky-hook has a wing made from spruce or balsa wood attached to the top of the container. The wings can be quickly removed and are interchangeable among various models.

FORTY per cent. increased output in synthetic rubber plants in the United States producing GR-S rubber is now possible by a new process developed by the Goodyear Tire and Rubber Company at its laboratories at Akron, Ohio. It is a continuous polymerization process to replace the older so-called batch type of operation. GR-S rubber is made by polymerizing or uniting the molecules of two materials, butadiene and styrene. It is done in large glass-lined tanks known as reactors. The temperatures in the reactors must be carefully controlled. In the batch type operation, each reactor is handled as a separate unit. In the new continuous process method, the reactors are connected together by pipe lines in groups to form a continuous chain. Carefully timed pumps admit the ingredients in a continuous stream in the exact portions needed. The reaction takes place as the mixture moves through the chain of reactors and GR-S latex pours forth from the last one in a constant stream. Ingenious controls keep the temperature exactly right in each reactor. They are operated at 100 per cent. full at all times, instead of 90 per cent. full as in the batch method, and no time is lost in filling or emptying the glass-lined tanks.

Recent publications in Quantitative Analysis

Arenson and Rieveschl

INTRODUCTION TO QUANTITATIVE ANALYSIS

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SCIENCE NEWS

Science Service, Washington, D. C.

PENICILLIN AND HEART DISEASE

PATIENTS with the kind of heart disease known as subacute bacterial endocarditis, heretofore almost always fatal, should be treated with penicillin if the heart ailment is due to a streptococcus sensitive to the drug.

This advice is given to the medical profession in a report by Dr. Martin Henry Dawson and Dr. Thomas H. Hunter, of the Presbyterian Hospital and Columbia University College of Physicians and Surgeons, New York, in the *Journal of the American Medical Association*.

It is based on apparent success of the treatment in fifteen out of twenty patients. These patients are in excellent health, free of all signs of the infection that caused their heart trouble, and all but three are back at work, housekeeping, or whatever their former occupations were. They might be called "cured" except for the fact that the period since the treatment was stopped is only a matter of months and in a chronic disease such as this more time is needed to be sure the germs causing the trouble have really been defeated.

Of the other five patients, two relapsed as soon as treatment was stopped, but they are in excellent general condition and it is hoped that they will yet be cured. The other three patients died. In two cases the infection was still present at the time of death and in the third the situation was doubtful.

Since the report on the twenty patients was written, seven more have been treated. Of these, six are well and one relapsed and is now getting additional treatment.

Drs. Dawson and Hunter first used penicillin to treat subacute bacterial endocarditis in 1942 and 1943. The results were encouraging but because supplies of penicillin were then so limited, only two got enough to make recoveries. Another two have since been treated with larger doses combined with the anti-blood-clot chemical, heparin, and they also have now recovered. The fifth died of stoppage of a blood vessel in the brain, but the post mortem examination showed "substantial healing" of the heart condition.

Besides giving much more penicillin to the patients treated during the past year, heparin was also used. The combination of penicillin and heparin was first tried by Dr. Leo Loewe and associates at the Jewish Hospital, Brooklyn, N. Y.

They tried heparin, with good results, because the germs that cause subacute bacterial endocarditis grow on the lining membranes of the heart in clumps mixed with fibrin from the blood. Buried in these clumps or clots, the germs are protected from chemical remedies circulating in the blood. Heparin counteracts the tendency of the blood to form clots in which the germs can grow safely and so should make the germs more vulnerable to attack by penicillin.

Drs. Dawson and Hunter found, however, that in five cases they got as good results without heparin as with it in other cases when large doses of penicillin were used. Giving this drug by continuous drip into the muscles instead of into the veins or by repeated injections into the

muscles keeps more of it in the blood and is more comfortable for the patient, as well as simpler when penicillin must be given over prolonged periods.

ITEMS

A NEW laboratory for improved physical and chemical utilization of wood and its products was officially opened in Washington on January 9. The Teco-Shop Laboratory of the Timber Engineering Company is appropriately located in the middle of a wooded area on the outskirts of the city. Hosts for the day were C. A. Rishell, director of research, and Harry Uhl, president of the Timber Engineering Company. The laboratory is composed of two divisions. Dr. Eduard Farber is in charge of the chemical division, which has already made advances in the study of the utilization of lignin, partner of cellulose in wood, but all too frequently regarded as a waste product. J. L. Sterns heads the physical department where soft grades of wood are made hard under impregnation.

THAT streptomycin, one of the newest of the germ-killing agents against-germ medical weapons, can exert a "striking suppressive effect" on tuberculosis in guinea pigs, is reported by Dr. W. H. Feldman and Dr. H. C. Hinshaw, of the Mayo Foundation and Clinic. What effect it might have in suppressing tuberculosis is not stated. Streptomycin, which is obtained from a bacillus that lives in earth, was discovered by Dr. Selman A. Waksman, Dr. Albert Schatz, and Dr. Elizabeth Bugie, of Rutgers University and the New Jersey Agricultural Experiment Station. They found it a powerful weapon against tuberculosis germs in test tube experiments and suggested the guinea-pig trials of the Mayo group, which has been investigating the antibacterial action of other new antibacterial substances. Streptomycin does not have any toxic effect on guinea pigs. Doses of human tuberculosis germs that cause widespread and destructive infection in the bodies of untreated guinea pigs caused hardly any detectable signs of disease in the animals that got daily doses of streptomycin.

THE importance of proper lubrication in machines of all types, from tiny wrist watches to giant locomotives and in gigantic war aircraft operating through desert dust and stratosphere cold, is now recognized to such an extent by technicians and chemists that a national organization has been formed with headquarters in Chicago and the first technical meeting is planned for February 8 and 9. The new association is known as the American Society of Lubrication Engineers. The objective of the association "is to put on a sound basis the fundamental precepts of lubrication," which it is believed will be of benefit to all phases of industry with their related problems. The society will also attempt to promote the training of lubrication engineers in engineering schools. C. M. Pritchard, Republic Steel Company, is president of the society, and B. H. Jennings, professor of mechanical engineering at Northwestern University, is secretary and treasurer.

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SCIENCE NEWS

Science Service, Washington, D. C.

THE PRODUCTION OF TUNGSTEN

TUNGSTEN and molybdenum, rivals for favor in the war-essential rare-metals family, are now available in sufficient quantities to meet the most important needs, among which are the 15,000 types of items used mostly in electric lamps and electronic tubes, according to the lamp division at Bloomfield, N. J., of the Westinghouse Electric and Manufacturing Company, one of the largest American producers of pure tungsten for electrical uses from imported wolframite ore. Its production of tungsten from the imported ore is now sixteen times as great as in pre-war years, and the production of molybdenum, from an American ore, has increased to about the same extent.

In pre-war years tungsten ore came principally from countries now wholly or partly under Japanese control. Chinese ore is reaching the United States, but it has to be brought by aircraft transport into India and shipped from there by boat. The United States is one of the principal molybdenum mining and smelting countries.

For use in electronic tubes and lamps, both tungsten and molybdenum must be in a high state of purity. The processing of both requires intricate and precise handling. The metals are reduced to powder form and later pressed into ingots strong enough to be drawn into very fine wire or to be formed into rods and sheets. Both these metals have high melting points, both have electrical conductivity about one third that of copper, and both compare favorably with the more expensive metals, platinum and tantalum, in their ability to resist corrosion.

Tungsten is slightly superior to molybdenum in some respects, but it is limited as to size and form, and weighs twice as much. It is one of the heaviest of all metals. It has the highest melting point of all. High-speed cutting tools are approximately 20 per cent. tungsten, and can be used on a lathe until red hot without losing hardness. Tungsten alloys, particularly steel alloys, are used extensively in many types of machines and especially in war munitions.

Molybdenum is a silvery white metal with a high melting point, and is used extensively in steel alloys to increase tensile strength, as well as in electric lamps and electronic tubes. It is also used in high-speed cutting tools as a substitute for tungsten. In steel alloys it is particularly valuable in protecting against corrosion, and especially against sulfur corrosion. It is called indispensable in vacuum tubes and all other electric equipment where high conductivity, great strength and rigidity at high temperatures are required.

ITEMS

OVER 400,000 words a day are sent out by the Army's super radio station in France, that has direct hookups with London, Washington and the Army's worldwide radio communication system. The multiple-channel 40-kilowatt station, costing an estimated \$2,000,000, was sending and receiving trans-Atlantic messages 25 days after it arrived in France in 1,000 shipping boxes. The power of this station may be compared to some of the

major standard broadcasting stations in the United States. Station KNX in Los Angeles, WBBM in Chicago, WLW in Cincinnati and WABC in New York are all rated 50 kilowatts, and these are among the most powerful broadcasting stations in the country.

A NEW and important library collection on military aeronautics has just been started by the Air Technical Service Command of the Army Air Forces at Wright Field, Ohio. The collection already numbers more than 3,000 volumes and is used daily by research engineers assigned to development and experimental projects. Many early books on aviation subjects, some dated as early as 1784, provide valuable historical background, while more recent technical data, American and foreign, are essential to the ATSC's responsibility for development and experimentation on new aviation equipment. Miscellaneous material, including air combat intelligence reports from World War I and back issues of aviation magazines and newspaper clippings on aviation subjects, have also proved valuable. The ATSC invites the public to contribute pertinent material to the Wright Field Library. Persons interested in making such contributions are invited to write a letter describing the documents they have. Correspondence should be addressed to: Chief, Technical Data Laboratory, ATSC, Wright Field, Dayton, Ohio.

EPIDEMICS of streptococcus sore throats and scarlet fever that threatened the technical schools of an Army Air Force were prevented and cases of these ailments reduced almost to zero by sulfadiazine prophylaxis, according to a report made by Capt. Richard G. Hodges of the Army Medical Corps in the *New England Journal of Medicine*. Cases of pneumococcal pneumonia were also significantly reduced, as were attacks of ordinary respiratory disease which the layman would call a cold. Rhinitis, pharyngitis, laryngitis and acute bronchitis were included in this group. Captain Hodges suggests that the effect of sulfadiazine prophylaxis in reducing these ailments is probably because a fair proportion of them were caused by bacteria and not by the virus of the common cold.

QUICK, easy, inexpensive and accurate is a new method, using an indicator solution recently developed, to distinguish between manganese bronze and aluminum bronze in scrap and other metal. In the past this has been largely guesswork, because of the similarity in appearance of the two alloys. The discovery was made by the U. S. Bureau of Mines at its experiment station at Pittsburgh. To make the test, a small area of the metal is cleaned thoroughly of all dirt, scale and grease by grinding. This spot is then sprayed with a sulfuric acid solution. After the acid has had several seconds to react, a drop of the indicator solution is added. If the metal is manganese bronze a grayish-purple spot appears; but if it is aluminum bronze the spot is greenish-yellow. The indicator solution consists of varied weights of ammonium-mercury thiocyanate, silver nitrate and ammonium persulfate.

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• ELEMENTS OF BIOLOGY

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By PERRY D. STRAUSBAUGH and BERNAL WEIMER

A more comprehensive treatment than "Elements of Biology," by the same authors, this textbook gives a fundamental understanding of structure and function, and pictures the organism as a whole.

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• GUIDE TO THE STUDY OF THE ANATOMY OF THE SHARK, THE NECTURUS, THE CAT

By SAMUEL EDDY, *Associate Professor of Zoology*, C. P. OLIVER, *Associate Professor of Zoology*, and J. P. TURNER, *Late Assistant Professor of Zoology*; all at the *University of Minnesota*

A manual to serve as a guide in dissecting the animals described, this book is excellent for laboratory courses in comparative anatomy. ("Atlas of Outline Drawings of the Dogfish Shark, the Necturus, and the Cat for Vertebrate Anatomy," an aid in studying anatomy of these animals. 1940, 77 sheets, \$1.50.)

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• ESSENTIALS OF HUMAN EMBRYOLOGY

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Second edition; 1938;
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SCIENCE NEWS

Science Service, Washington, D. C.

DDT AND MALARIA

THAT DDT, already acclaimed for success in aborting the typhus epidemic in Naples, now is helping to control malaria and fly-borne diseases, is reported by Major George C. Brother, of the Medical Corps, attached to the Fifteenth Air Force. Units of enlisted airmen directed the killing of adult mosquitoes and flies in the area, using a 5 per cent. DDT solution in kerosene, applying it with power paint sprayers, hand spray guns and paintbrushes to prevent the spread of malaria and diseases carried by flies. The mixture is applied by two-man teams to military mess halls, kitchens, latrines, and civilian as well as military sleeping quarters.

DDT arrives in Italy in hard, waxy lumps, which are pulverized in a meat grinder. The solution is made up by adding the pulverized DDT to kerosene and pouring it into five-gallon oil cans. Cans of this mixture are stacked in the sun to hasten solution and are rolled around on the ground every twenty-four hours. A good solution is obtained in about four days.

Spraying teams, after a half-day of schooling in malaria control, begin applying the poisonous solution to walls, doors and screens of buildings. The men wear protective masks. These teams also seek out near-by breeding places of flies and of mosquitoes which might infect soldiers with malaria.

Some reports indicate that the insecticide did not have immediate results. However, after several days medical officers were convinced of its effectiveness. Observations show that areas have to be re-sprayed about every month or six weeks.

According to Major Brother, the results have been spectacular from the standpoint of pest control, and DDT can be considered valuable in the prevention of both malaria and enteric diseases.—ROBERT N. FARR.

ITEMS

A MEMORIAL to be erected in honor of the defenders of Leningrad will include new buildings for Pulkova Observatory, according to Professor Grigori Neumin, director of the observatory. Pulkova Heights was one of the keypoints in the defense of Leningrad, so it is fitting that the memorial, which will form an architectural whole with the observatory buildings, be erected there. The staff of Pulkova Observatory, which was evacuated to Tashkent, Turkestan, nearly three years ago and conducted observations with instruments belonging to Tashkent Observatory, is now preparing to return home. Several years will probably be needed, however, to put the observatory back into shape, although the instruments will be in use long before that time, according to the Soviet Information Bureau at Moscow. Part of the observatory buildings will be restored to their former appearance, the rest will be modernized.

ALMOST twice as many cases of undulant fever have been reported to the U. S. Public Health Service so far this year as during the corresponding period of 1944.

The total up to February 3 was 354, compared with 184 for the same period last year. Undulant fever is also known as Malta fever and brucellosis. It is not often fatal but is a long drawn-out sickness, lasting sometimes for years. The suffering, disability and economic loss are considerable. People get undulant fever, usually from drinking raw goat's milk or raw cow's milk that contains the germs. Pasteurizing milk is a sure safeguard against undulant fever from this source. Humans may also get the hog variety of brucellosis, but this is not very common. Farmers, vegetarians, slaughterhouse employees, butchers and even cooks can get it from handling infected meat or from close contact with infected animals. Reporting of cases of undulant fever is now required in all 48 states and the District of Columbia. Last year, however, was the first in which all states reported the disease. It is possible that during this first year not all cases were reported while more are being reported this year. This might account for some of the increase.

A PARALYSIS that afflicts honeybees, causing wholesale death in the hives, has been found to be caused by a filterable virus, just as infantile paralysis in human beings is caused by another virus. The bee disease was traced to its microscopically-invisible cause by Dr. C. E. Burnside, of the Bureau of Entomology and Plant Quarantine. Loss of hair from the bees' bodies, hitherto considered a symptom of honeybee paralysis, was found to be undependable as a means of diagnosis, for the bees to which he purposely gave the disease in his experiments did not become partially naked and shiny. Dr. Burnside is inclined to believe that loss of hair is not a true symptom at all, but is probably due to the tendency of other bees to bite and pull at the sick ones in an effort to get them out of the hive. Much more dependable symptoms, he reports, are sprawled legs and wings and a general trembling of the whole insect. Now that the disease has been traced to a virus, means of prevention or cure can be sought for more intelligently, and with greater hope of ultimate success.

SYNTHETIC rubber now can replace natural rubber in another field—in the production of chlorinated rubber for ship-bottom paints, anti-fouling paints, and non-inflammable paints. Chlorinated synthetic rubber can be used also in the preparation of sand-core binders for molding operations, adhesives and other products. The new synthetic chlorinated rubber is a development of the Good-year Tire and Rubber Company in its laboratories at Akron, Ohio. The new chlorinated synthetic rubber is a creamy white powder containing from 60 to 70 per cent. chlorine. It is equal to the natural rubber product in every way, it is claimed. It is soluble in all aromatic hydrocarbons, including benzene and toluene, and also in esters like ethyl acetate and in chlorinated hydrocarbons. It is non-inflammable, is resistant to both acids and alkalis and has excellent anti-corrosion qualities.

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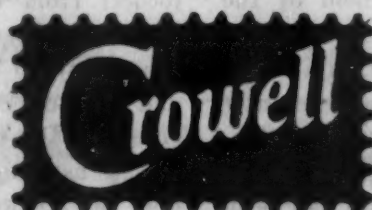
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SCIENCE NEWS

Science Service, Washington, D. C.

A "STARLIGHT" TUBE

A "STARLIGHT" tube, it is called, a new super-sensitive electronic tube smaller than a 25-watt incandescent light bulb, can be used to measure accurately the feeble quantity of electricity in the light of a star many million-million miles away. It has, however, very practical essential wartime uses in the electro-chemical analysis of metals such as steel, and the detection of impurities in high explosive compounds.

The new tube and its development were described at the New York meeting of the Institute of Radio Engineers by William A. Hayes, of the Westinghouse Electric and Manufacturing Co., who is responsible for its present development.

The minimum amount of electric current which the tube can measure, one one-hundred-trillionth ($1/100,000,000,000,000$) of the electric energy in the light from an average home reading lamp, actually is less than the minute electric current in the dimmest starlight.

When astronomers seek information concerning changes in a planet's direction, speed or other characteristics, they hitch the tube, which is attached to a photoelectric cell, to the "eye" end of an observatory telescope. On the basis of the starlight readings, the distance between the earth and the stars is determined by trigonometric computation.

The sensitivity of the tube, which must be operated in total darkness to keep ordinary daylight from energizing the grid, is derived from its unorthodox design and construction. Glass "pants-legs" are tailored around the stiff metal wires which support the tube's internal structure to prevent stray electrons from getting lost. Functioning like a lightning rod, a tiny tungsten wire is spot-welded inside the tube and pressed against its side to catch unwanted electric charges that might affect its accuracy.

A simple electronic tube contains a wire filament that shakes loose electrons when heated, a metallic mesh called a grid that acts as a control gate through which electrons must pass, and a plate that collects the electrons. In the new starlight tube the roles of the plate and the grid are interchanged; the grid functions as the plate and the plate as the grid.

ITEMS

A TINY floating magnet, that remains in the air without visible means of support over a lead plate cooled to a temperature only a few degrees above absolute zero, itself creates, it would seem, the power that holds it aloft. The probable explanation is that the magnetic field of the magnet sets up incessant induction currents in the lead, which, in turn, repel the magnet. This ability, in a ferro-nickel magnetized bar one centimeter long, was recently discovered by scientists in the Soviet Union and is reported by a corresponding member of the USSR Academy of Sciences. In the experiment, the lead plate had been cooled to 269 degrees below zero Centigrade, approximately four degrees above absolute zero. When the tiny

magnet was thrown on the plate it bounced into the air and remained floating until the temperature of the plate rose three degrees, when it settled on its surface. This action is dependent upon the very low temperature to which the lead was subjected. It has been known for years that at very low temperatures the electrical resistances of some metals drop very greatly. When cooled to this condition the metal is said to be superconductive. Lead becomes superconductive at 266 degrees below zero Centigrade, and mercury at 269 degrees. A current started by an electromotive force in a superconductive lead ring continues to flow for hours after the starting force is removed.

ABOUT the size of a quart milk bottle and mounted on the instrument panel of a B-29 Superfortress, the new air position indicator gives continuous readings of latitude and longitude as the heavy bomber executes its mission to Tokyo. This is the first device to give such readings in the history of navigation on the sea or in the air. Developed by the Eclipse-Pioneer division of Bendix Aviation Corporation, with the cooperation of the Air Technical Service Command at Wright Field and the Navy Department, the device eliminates the need for the navigator to work for hours with charts, basic navigational reference books, star-sighting sextants, and other aids to navigation to calculate the position of his airplane in flight. The navigator of a B-29 can pinpoint his position on the map and keep the plane on the skyroad to any enemy target, by referring to two needles on a small instrument panel dial of the air position indicator marked off in degrees of longitude and latitude. This same dial also gives him a continuous record of nautical miles flown and indicates the correct compass heading of the plane.

PATIENTS with severe streptococcus sore throats start to improve within 8 to 12 hours after the first injection of penicillin and may be well within 24 hours, Army medical officers found in studies reported in the *Journal of the American Medical Association*. Unless the patients continued to get penicillin treatment for six days, however, they suffered relapses. The greater effectiveness of penicillin over sulfadiazine in throat infections with hemolytic streptococci is stressed in the report by Major Norman Plummer, Miss Dorothy Rhoades Duerschner, Major Harold Draper Warren, Captain Francis T. Rogliano and Captain Ruell A. Sloan. "It should be used without delay in any serious, progressive hemolytic streptococci infection," they advise. The most striking finding, they point out, was the disappearance of the streptococci from the nasopharynx within 24 hours. This raises a number of questions such as whether it is possible completely to eradicate the streptococci from the body and what effect this would have on the course of the disease and the development of rheumatic fever or kidney disease as complications of strep sore throat. The study does not answer these questions, though it gave "some indication that complications of this disease can be prevented and effectively treated."

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SCIENCE NEWS

Science Service, Washington, D. C.

PRE-FABRICATED HOSPITALS

PRE-FABRICATED postwar homes and small buildings may be transported by air to the site where they are to be erected, as a result of the development of a portable hospital shelter which can be transported by air in two thirds the cargo space of a C-47 airplane. It weighs 3,700 pounds complete, and can be erected by a four-man team in two hours.

Two types of shelters have been developed. One is for use in warm, tropical climates, and provision for adequate ventilation has been stressed in its design. The other is for use in the Arctic, and suitable insulation has been incorporated into its construction.

Each unit has two rooms, one 16 by 16 feet and the other eight feet square. Windows can be opened or closed. Provision is made for the use of electricity, and there is a stovepipe outlet in the gable. Each unit has three doors, one to the outside from each of the two rooms, and the third connecting the rooms.

Developed by the Equipment and the Aero Medical Laboratory of the Air Technical Service Command, the small eight-foot entry room is large enough so that when a patient is brought in, the outer door can be closed before the inner door is opened. In cold regions this feature conserves heat, and in the tropics it keeps out insects and other pests. Each unit can accommodate twelve patients on litters, with enough space left for the room to be used for operations and as a dispensary.

If much space is needed, the units can be set up in combinations to meet the requirements of the local situation. Probably one of the greatest uses of the hospital shelters will be at advanced air bases. Here they can be erected near the airstrip so that a hospital plane can taxi up to the shelter and the patients, still on the original litters, can be loaded from the shelter to the plane for rapid transport back to more completely equipped hospitals.—ROBERT N. FARR.

ITEMS

MINIATURE electron tubes recently developed in the laboratories of the Radio Corporation of America, at Camden, N. J., will permit the construction of smaller home radio receiving sets and compact radio-television-record player combinations in postwar days. They are now in use in war equipment. Typical savings of 20 per cent. to 40 per cent. in equipment size will result. The new tubes, some as small as the little finger, are a "wedding" of the acorn type tube, developed in the ultra high frequency field, and the filament-type miniature tube developed in 1938. By merging the special features of the two earlier types, a combination is made of the efficient high frequency performance of the acorn with the smaller size and lower cost of the miniature. The new tube has the cathode-type inner structure of the acorn, and the small envelope and base of the filament-type miniature.

THAT synthetic rubber is here to stay on its own merits, and it will no longer be used merely as a substitute for natural rubber, is reported by E. F. Riesing, chairman of

the National Division of Rubber and Plastics of the American Society of Mechanical Engineers, and chief automotive engineer of Firestone Industrial Products Co. At the New York meeting of the society he pointed to the superiority of the synthetics in specific physical properties such as resilience, efficiency, low-temperature flexing, low-temperature brittleness, high-temperature stability, resistance, resistance to ultraviolet rays, ozone, acid, diffusion and other important properties. The facts presented by Mr. Riesing were based upon extensive tests simulating temperature conditions in the African desert and in Alaska. One type of synthetic rubber, a polybutadiene compound, will not freeze or become brittle under stratosphere low-temperature conditions. The particular type of rubber freezes at 100 degrees below zero Fahrenheit.

A NEW seven-cylinder air-cooled radial engine that develops 700 horsepower on inexpensive low-octane fuel has been announced by G. W. Vaughan, president of the Curtiss-Wright Corporation. Known as the Cyclone 7, the new engine will permit airplane manufacturers to design short-range cargo planes and military trainer planes around a 700 horsepower installation. The new engine is similar to the nine-cylinder Curtiss engine which powers more than eighty per cent. of the nation's airlines. Close resemblance between the two makes it possible to interchange many parts, thus reducing maintenance problems. The combustion chamber is designed for gasoline of an octane rating much lower than that of planes in the air to-day. Horsepower output would be correspondingly greater if higher-octane fuels were used. The new engine is provided with a two-speed supercharger drive. The higher supercharger ratio is adequate for the development of maximum engine power at high-altitude airports. The lower supercharger ratio supplies extra power for high performance at airports situated at low altitudes. To improve lubrication within the engine, oil has been provided in the crankcase to direct a continuous flow of oil into each cylinder barrel.

BUILDERS of modern aircraft, like the giant B-29 Superfortress which has over ten miles of electrical wiring, may benefit from a new connector block system of electrical connecting that eliminates many of the plugs and sockets, yet permits additional electrical systems to be added with ease. Developed by the Technical Board of the Society of British Aircraft Constructors, the new system employs a series of connector blocks with leads directly to the main power source, a generator or batteries. Simplified plug-in leads extend from the connector blocks. The blocks, made from lightweight plastic, are available in two-, three-, five- and 15-way units, either in single or double tiers. Should it become necessary to increase the number of leads, another connector block of larger capacity is added. Compact in size, the new connector blocks are not much larger than an ordinary match box. The five-way unit measures 2½ inches wide, 1½ inches high and 1½ inches deep. The new system is standard for all new types of British aircraft.

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SCIENCE NEWS

Science Service, Washington, D. C.

THE NUMBER OF SCIENTIFIC MEN
AVAILABLE

A TWELVE-YEAR shortage of the most essential scientists for war and industrial research as the consequence of the non-technical use of scientists and science students in the fighting forces is forecast by Dr. Gaylord P. Harnwell, of the University of Pennsylvania, writing as editor of the *Review of Science Instruments*.

In this war with radar, airplanes, and other such devices, the nation's technical superiority is due to research in the field of physics, although chemistry played the chief role in the first World War. Figures show, however, that the number of physicists in training in this country has dwindled alarmingly.

The number of physicists who were granted the doctor's degree has dropped markedly in the war years, with only 55 in 1944 compared with a peak of 191 in 1941. Dr. Harnwell takes 26 as the average age at which a doctor's degree is received, 1941 as the last year in which a normal number of degrees were awarded, and finds that even with a revival of training of 18-year-old students in 1945 there will be a gap of 12 years during which very few physicists will be available.

The nation will be short 1800 graduate physicists in 1953, compared with present 2833 Ph.D. physicists listed in the National Roster of Scientific and Specialized Personnel. The situation is made worse by the demand expected for physicists to conduct researches for industry in the postwar era.

Unlike colleges in the United States, British and Soviet technical schools have been allowed to keep up their enrollments as a war and postwar measure. An authoritative British report states that their output of engineers and physicists has more than doubled during the war.

Because many professors have been drawn away from the colleges for war research, the problem now and in the immediate future is not merely a matter of getting students into the colleges, but of reorganizing the teaching staffs to teach them.

ITEMS

NEW hybrids of sweetcorn developed during the past season, used in connection with older hybrids, will make it possible for the home gardener from one planting to pluck corn in the pink of condition every day from early summer to frost. These new hybrids were developed by the Connecticut Agricultural Experiment Station, and, although not yet thoroughly tested, give good promise. One matures earlier than older early hybrids, the other later than the better-known late varieties. If six varieties of corn, in what is called a succession series by the station, are planted at the same time, mature corn will be available throughout the season. As one passes maturity the next will be ready for the table. The new hybrids are expected to extend the sweetcorn season appreciably. Information on the succession series is available in the annual sweetcorn report of the station.

A NEW lettuce variety, valuable for summer use because it does not shoot up a flowering stalk and "go to seed" as soon as warm weather comes, is announced by the U. S. Department of Agriculture. Propagation stocks of seed are now being distributed to growers, and it is expected that enough seed for general planting will be available by the spring of 1946. The new lettuce was developed by Dr. Ross C. Thompson at the Plant Industry Station at Beltsville, Md. It has frilled light green leaves with the very wrinkled surface known to horticulturists as "savoyed." Gardeners refer to the "going-to-seed" process in lettuce as bolting. Because of its reluctance to do this, the new variety has been named "Slobolt."

A NEW development in the Diesel engine field permits the use of either gas or oil as fuel without any electric sparking device, saves from 20 to 25 per cent. in fuel consumption, and enables the change from one fuel to another without the necessity of a shut-down. It is a development of the Cooper-Bessemer Corporation. Any engine built as a Diesel can be fitted to operate on gas, but engines built purely as spark-ignited gas engines can not be converted to work on the principle of the Diesel. Conversion of Diesels from one type of fuel to another has been possible in the past, but it has always been necessary to shut down and exchange major or minor parts. With the new development conversion is as simple as closing one valve and opening another, and it can be arranged so that the engine automatically goes from one to the other as the gas availability changes. "Assuming a Diesel oil engine in operation and on load," Ralph L. Boyer, Cooper-Bessemer Corporation engineer says, "if gas is admitted in the intake air the governor obviously will immediately reduce the amount of oil to compensate for the percentage being carried in the gas. It then merely becomes necessary to reduce the fuel oil injection to the desired minimum and then govern the percentage of gas according to load."

WHITE dwarfs may be pulsating stars like the giant Cepheids, Dr. P. L. Bhatnagar, of the University of Delhi, reports in *Nature*. Although the pulsation may be too rapid to be observed directly, it may still exist in three exceptional stars which are of high temperature but still with an average density so great as to be almost incredible—sometimes millions of times that of water. The period of the pulsation would probably be less than ten seconds. There seems to be no theoretical reason why the rhythmic expansion and contraction of a star, so far observed only in giant and super-giant stars, should not take place in denser stars and even in white dwarfs where the atoms have been stripped of their electrons. After a white dwarf has been created by the sudden collapse of a star, it is quite natural that the star should be left pulsating. Even if the physical conditions do not favor maintaining such action of the star, Dr. Bhatnagar estimates that, once started, the pulsation might last for about 1,000 years before it dies out.

SCIENCE NEWS

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SCIENCE NEWS

Science Service, Washington, D. C.

INFRARED AURORAL DISPLAY IN
THE NIGHT SKY

AN infrared aural display has been detected in the night sky. This radiation of waves, invisible to the human eye and far more intense than the ordinary persistent aurora, is probably due to a large number of nitrogen atoms in the high atmosphere, according to Professor Joel Stebbins, Professor A. E. Whitford, of the Washburn Observatory of the University of Wisconsin, and Dr. P. Swings, of the Mount Wilson Observatory of the Carnegie Institution of Washington.

This strong infrared radiation was first detected in 1940 on a photograph of the great Andromeda nebula made with an infrared filter, they report in the *Astrophysical Journal*. In 1944 the infrared sky was found unexpectedly to be of nearly twice its ordinary brightness and to be fluctuating by 10 per cent. to 15 per cent. within 10 minutes.

"The infrared radiation is obviously much brighter than any other part of the spectrum, including the persistent aural line at 5577 Angstroms, for which we have never found any effect," the astronomers state. "With allowances for the continuous sky spectrum, the infrared radiation is probably scores of times—perhaps even a hundred times—as strong as the line in the green."

The main source of the radiation is probably near 10,000 Angstroms, where it would be between two strong water-vapor absorption bands.

The infrared radiation is believed to be atmospheric because it varies with the distance from the zenith, decreases through the night, and varies irregularly from night to night and from season to season. It is brightest immediately after twilight.

In order to estimate the height above the earth's surface at which the rays are emitted, it is suggested that measurements be made at widely different zenith distances every minute or less, and that they be carried to near the horizon. The radiation should also be studied soon after sunset and before sunrise to find the effect of solar radiation.

ITEMS

PARTS of the radio spectrum, until recently used only for experimental work, are now being employed by the Navy Department in radio for aircraft. Radio-altimeters and direction finders are only a few of many new devices that employ these hitherto little-used radio frequencies. They enable naval aviators to search out and attack the enemy when he is at a disadvantage due to adverse flying conditions. To help the pilot and crew make use of these new devices, a simplified semi-automatic aircraft instrument control has been put into operation. Of first importance are automatic engine controls that relieve the pilot of the necessity of observing and setting countless dials and gages. Navy pilots now have improved electrical gyro instruments that operate reliably under the extremely low temperature conditions experienced at high altitudes and

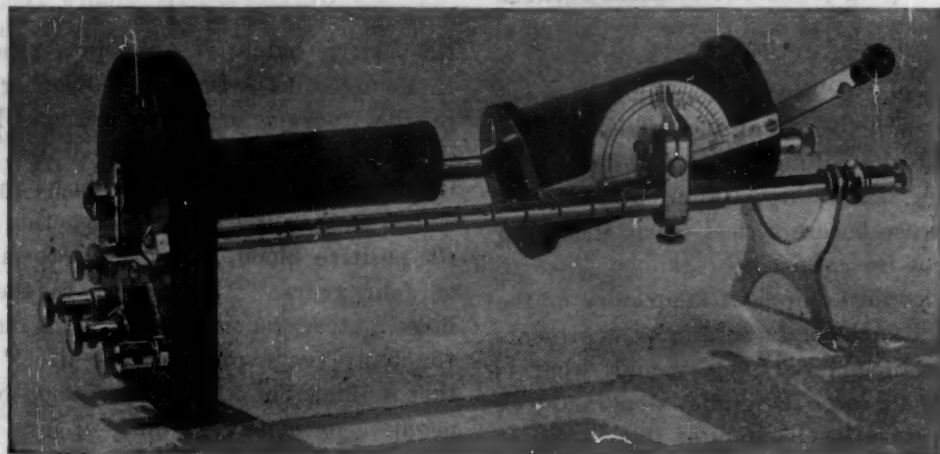
throughout violent acrobatics often necessary in outmaneuvering the enemy in combat. New and better compasses of both gyro-stabilized and remote indicating types, as well as air position indicators, help to simplify navigational problems.

THE standard frequency broadcast service of the National Bureau of Standards now includes 24-hour service on 15 megacycles which was previously confined to the 12-hour period from 7:00 A.M. to 7:00 P.M. Other frequency services remain unchanged. The bureau's standard frequency broadcast, that makes the national standard of frequency widely available, includes standard radio frequencies, standard time intervals accurately synchronized with basic time signals, standard audio frequencies and standard musical pitch. Four radio carrier frequencies are used by the bureau; three are on the air at all times, to insure reliable coverage of the United States and other parts of the world. The frequencies are: 2.5 megacycles, which is 2,500 kilocycles (2,500,000 cycles) per second, broadcast from 7:00 P.M. to 9:00 A.M., Eastern War Time; 5,000 kilocycles, 10,000 kilocycles and 15,000 kilocycles, these three continuously day and night. Two standard audio frequencies, 440 cycles per second and 4,000 cycles per second, are broadcast on the radio carrier frequencies. Both are broadcast continuously on 10 and 15 megacycles. Both are on the five-megacycle band in the daytime, but only the 440 is on five megacycles from 7:00 P.M. to 7:00 A.M. Only the 440 is on 2.5 megacycles. The 440 cycles per second is the standard musical pitch, A above middle C; the 4,000 cycles per second is a useful standard audio frequency for laboratory measurements. All broadcasts are from the bureau's station WWV, near Washington.

THE electronic vulcanization of rubber may become common in the near future, replacing the familiar heating method, with the securement here of the basic patents covering the new process granted on discoveries made by R. A. Dufour and H. A. Ledue, of France, and by E. E. W. Kassner, of Switzerland. The purchasers of the patents are the B. F. Goodrich Company and the Firestone Tire and Rubber Company, who plan to make them available to other companies in the rubber and plastics industries on a reasonable basis. Electronic vulcanization will speed production, but, more important, will give more uniform and higher quality products. Vulcanization is the joining of rubber molecules and sulfur. For more than a century, rubber has been vulcanized by applying heat to the outside surface. Since rubber insulates against rather than conducts heat, heating to the core by this method is slow and lacks uniformity. In electronic heating the core is heated quickly. In electronic vulcanization, high-frequency oscillations shake the molecules of rubber and sulfur millions of times a second, creating uniform heat throughout the product being vulcanized in a fraction of the time required when steam heating is used.

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SCIENCE NEWS

Science Service, Washington, D. C.

TELEPHONE WIRE OVER THE GREAT SMOKY MOUNTAINS

AN airplane that looks like one used by commercial airlines succeeded in laying 16 miles of telephone wire over the rough, wooded slopes of the Great Smoky Mountains between Tennessee and North Carolina in 6½ minutes, a report from the Air Technical Service Command at Wright Field reveals. Flying low over elevations between 1,500 and 5,000 feet, the wire was laid for use by National Park Service rangers.

The wire-laying project was accomplished last October by a C-47 cargo plane with the aid of the ATSC and the Bell Telephone Laboratories. Rangers used the wire for communication between Gatlinburg, Tenn., and Smoke-mont, N. C., for five weeks before a sleet storm sheathing the wire with an inch of ice caused a break.

"This development by the equipment laboratory of the division and the Bell Telephone Laboratories represents an immense saving in time, labor, money and, what is more important, lives," declared Brigadier General F. O. Carroll, chief of the engineering division of the ATSC.

Setting up standard telephone poles for 16 miles over the mountainous terrain would have required many men and many days. Applying the method to military operations, a length of wire could be laid over an area open to enemy artillery fire, probably without the loss of a single life. It is common in this war to lose many lives establishing even short-distance field communications.

In operation, the present method of laying wire from the air uses eight wooden boxes, each containing two miles of wire. The wire is boxed and wound so that there will be no snarls, broken wire, fraying of insulation or other troubles. The wire in each box is spliced to the wire in the next box, so that the unit is actually one long line.

From the front end of the lead box extends a long metal tube, like the barrel of a big camera lens. To the lead end of the wire is attached a chain and a parachute, which are tossed from the plane's side door over the spot where the wire is to be laid.

Only four men, including pilot and co-pilot, are needed to handle the 16 miles of wire in each plane. There are no special attachments or modifications to the plane.

In 1942 the idea of laying wire by airplane was presented to the National Development Research Council, which, in collaboration with the Signal Corps, began a six-month project. Although moderately successful, the project lay dormant until last year.

ITEMS

A HUNDRED and thirty billion units of penicillin, or about 6,500,000 doses, are being supplied to the nation's drug stores, hospitals and drug supply houses. By April 1, 130,000,000,000 units will be available for civilian use by War Production Board allocation. (From 5,000 to 40,000 units are needed in each injection, depending on the illness.) This is more than three times as much as

has ever been released for an entire month by WPB's civilian penicillin distribution unit in Chicago. For the month of April, the civilian allocation will be increased to 150,000,000,000 units. After that, monthly allocations are expected to be increased each month.

WARNING that great care should be taken in giving blood transfusions to women with Rh negative blood who have given birth even as much as 16 years earlier to Rh positive babies is given in a report by Dr. Lawrence E. Young and Dr. Donald H. Kariher, of Rochester, N. Y., in the *Journal of the American Medical Association*. Some physicians have believed that the antibodies built up in the mother's bloodstream by the Rh positive infant which may cause a violent reaction to transfusion with Rh positive blood, will disappear in the course of three or four years. "Sensitivity to the Rh factor," these investigators report, "once it is acquired, may persist for many years, probably for life." It is recommended that nothing but Rh negative blood be transfused into Rh negative patients regardless of how long it is since they gave birth to an Rh positive baby or of previous history of transfusions.

JOHN O'HEARN, of the Big "O" ranch, reports that airmen stationed at the AAF Flexible Gunnery School at Laredo, Texas, have found that camouflage suits eliminate the need for blinds or concealed spots when duck hunting. Wearing a green and brown camouflage similar to those worn by commandos, marine and other fighters in invasions, gunners can sit on a river bank and fire away at ducks who even will sit down on the water a few feet away. Their camouflage suits cause the hunter to blend into the natural coloring of the spot they have picked. This does away with the blinds and effectively hides them from the eyes of a cautious duck. Camouflage suits can also be used to stalk deer, hunt coyote, rabbit and other wildlife. A hunter may have a camouflage suit to blend with every season's coloring and every type of terrain where he may wish to hunt.

HEAVY rolling of shoe sole leather, or compression by other means, produces an improvement in wear, it is found by recent tests made by the National Bureau of Standards, in which a regiment of soldiers in an officer candidate camp were used, together with some civilian workers in war industries. The tests showed also that differences in the wearing quality of twenty commercial tannages of vegetable sole leather were very small, with no significant difference in the wear of leather tanned from domestic and from cold-storage hides. They showed further that water-soluble materials and grease are lost from soles in service, the greatest loss being shown by water-soluble ash. The so-called "rubber" abrasive machines are of little use in predicting the wearing qualities of tannages. The wearing quality can be estimated, to a degree, by the water-soluble content, the firmness, and the degree of tannage.

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SCIENCE NEWS

Science Service, Washington, D. C.

HIGH-SPEED CAMERAS

NEW high-speed motion picture cameras that will take as many as 8,000 pictures in one second help engineers to see the rapid, complicated movements of their machines "magnified" in slow motion, according to the report of Dr. H. J. Smith, of the Bell Telephone Laboratories, at a meeting of the American Society of Mechanical Engineers.

Three new high-speed cameras, developed by the Western Electric Company, use a method of optical compensation to take their pictures. They differ mainly in that they are built to employ different widths of film. The eight-millimeter camera takes 8,000 pictures in one second. The film is the same as used in "double-eight" home movie cameras. The exposure time for these pictures is 33 microseconds, and when projected in a standard eight-millimeter movie projector, the pictures are slowed down in the ratio 500 to 1. (A microsecond is a thousandth of a second.)

The 16-millimeter camera takes up to 4,000 pictures per second, each picture receiving an exposure of about 83 microseconds. The camera weighs only 35 pounds. By the simple expedient of photographing the action at 4,000 pictures a second, and projecting the pictures at 16 pictures a second on any standard projector, the action that was photographed will be retarded or "magnified" by the ratio of these two speeds, or 250 to 1.

Just recently the Bell Telephone Laboratories have developed a wide angle, 35-millimeter high-speed camera that will take up to 3,500 pictures a second on a professional size movie film. Designed primarily for high-speed studies encountered in aeronautical and ballistic research, the camera takes a picture with a field of view up to an angle of 40 degrees. This is equal to a 71-foot field of view at a distance from subject to camera of only 100 feet.

The optical compensation method of high-speed photography used in these three cameras, which are sold under the trade name "Fastax," uses a rotating compensating glass prism placed between the lens and the film in the camera. In the 16-millimeter camera the prism is shaped like a cube, having two pairs of parallel glass faces. This prism is placed inside a housing having four apertures which rotates around the prism. This acts like a barrel-type shutter. The film moves continuously past the picture aperture and four pictures are exposed during each revolution of the prism. The exposure time is controlled by the speed of rotation of the prism housing.

The eight-millimeter camera employs an octagonal shaped prism, having four pairs of faces. The 35-millimeter camera employs a four-faced prism like that used in the 16-millimeter camera.

The high-speed camera used to make slow motion pictures of prize fights, athletic events and horse races seldom runs above 128 pictures a second.

Lighting the subject must be given careful considera-

tion when taking high-speed pictures. Generally speaking, the amount of light required will be in direct proportion to the speed with which the pictures are taken. Thus, about 500 times as much light is needed to take pictures at 8,000 a second as at 16 a second. With a camera operating at 1,000 pictures a second, photo-flood lamps may be used. Pictures can also be taken outdoors in bright sunlight at this speed.

ITEMS

A SAD story of ill consequences following an effort by farmers to do good in their fields is told by Dr. John T. Middleton, of the California Experiment Station at Riverside. A disease of tomato plants that seemed to be a kind of mosaic appeared in certain California tomato fields. Leaves were mottled, fruits few in number and small in size. However, efforts to reproduce it by inoculating other plants with juice from diseased specimens were unsuccessful. When a check-up was made of the history of the fields in which the trouble occurred, it was learned that in every case a chemical weed-killer, sodium chlorate, had been used at some time in the past in an effort to control bindweed, one of the worst of plant pests. The more recent the treatment, the more severe were the symptoms on the tomato plants. However, effects were noted when the last application of the chlorate had been made five years previously.

A NEW pocket-size solar still assures a continuous supply of fresh water to Army and Navy fliers forced down in tropical waters. The still, under average conditions in the Southwest Pacific, can convert salt water into safe drinking water at a rate of more than a pint in eight hours. Under ideal conditions it can turn out almost double that amount in the same period of time. The basic idea for the sunstill, manufactured by the Gal-lowhur Chemical Company, was conceived by Richard Delano, of Locust Valley, N. Y. It actually harnesses the rays of the sun to make drinking water of sea water. The still itself consists of a vinyl plastic envelope folded into a pocket-size package. It is inflated like a balloon and tied alongside the lifeboat or raft, so that it floats on the water. A black cellulose sponge, stretched through the middle of the envelope, soaks up water and absorbs the heat of the sun. Then, through evaporation and distillation, the sea water is converted into safe drinking water. There are no moving parts, and the device will work indefinitely. Until the development of the sunstill there were only four other methods of providing survivors with water—the first essential to their well-being: equipping the craft with canned or bottled water; catching rainwater in a tarpaulin; the use of desalination briquettes, and the squeezing of water from fish. The sunstill has high priority on the list of equipment used for air-sea rescue in the Pacific.

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SCIENCE NEWS

Science Service, Washington, D. C.

RADAR FOR AIRPORTS AND PLANES

RADAR will help to make postwar air travel even more safe as the result of research started by the Civil Aeronautics Administration, which is expected to increase the safety factors of flying in fog, snow, rain or when the ground is obscured by clouds, called "instrument weather" by pilots.

Experimentation now under way at the CAA Experimental Station at Indianapolis is aimed at the perfection of two radar devices, one for airport use, and the other, a collision warning device, for use in the airplane itself. About 10 carloads of radar equipment have been loaned to the CAA for this research.

A radar tower controller for airports will permit the control tower operators to visualize on a screen the actual position of all aircraft within a radius of about 25 miles. This would detect immediately any hazardous condition that might occur because of pilot's error, or some mechanical failure in the radio landing system. The operator could adjust the control of outbound traffic at a fog-bound airfield with complete knowledge of the exact position of all incoming planes. To-day, the only way an operator can determine the position of planes near his field is through position reports which are radioed in by pilots. Only one of these pilots' reports can be handled at a time, and the estimates are not always accurate.

The collision warning device is designed to be mounted on the instrument panel of the airplane. Not just another gadget to clutter up the already jammed instrument boards in most planes, the radar screen will be extremely valuable. It will report to the pilot his position in the air relative to other aircraft, and to obstacles in his path, such as radio towers, beacons, water towers and similar objects that may be hidden from his sight when the ceiling is low.

In actual operation of the collision radar instrument, pilots would be responsible for maintaining the proper distance from other aircraft while climbing to assigned altitudes and while approaching an airport for a landing. The complete landing approach could be handled by the pilot with the control tower acting as a monitoring agent through its radar screen. This would speed up landings and take-offs in bad weather.

A radar collision warning device was developed several years ago by the CAA, but it was too heavy and too expensive for general use. Wartime demands have speeded up the refinement and practical application of this device.

ITEMS

MECHANICAL, electrical and non-chemical patents, seized from enemy aliens and nationals of occupied countries by the American Government, have been abstracted and the abstracts printed. They are available in five volumes containing information relative to 37,000 patents, or in separate sections by subjects. Two thirds of the patents were granted to Germans. Abstracts of 8,000 chemical patents have previously been made available. The patents

now abstracted include such broadly diversified fields as aeronautics, brakes, electric lamps and heating, electric furnaces, foods and beverages, internal combustion engines, machine elements, motors, printing, electronics and refrigeration, as well as many household articles. Telephony, telegraphy, textiles and tools are also included. The abstracts consist of the inventor's claim to the patent and a reproduction of the drawing as published in the *Official Gazette* of the U. S. Patent Office. Licenses under most of these patents are readily obtainable by any United States citizen upon application and payment of an administrative fee of \$15 per patent. Over 9,000 have already been licensed by the Alien Property Custodian to nearly 700 persons or firms. This office issues all licenses.

How long has Australia had human inhabitants? This question is being threshed out anew as a result of the discovery of a human skull in an undisturbed deposit estimated to be 50,000 years old, near Keilor, Australia. This would seem to give the skull an age of 500 centuries. However, Dr. Franz Weidenreich, of the American Museum of Natural History, has made a careful examination of the specimen, and he states, in the issue of the *Journal of Physical Anthropology* which appeared recently, that this skull is very similar to another ancient Australian relic, known as the Wadjak skull, which was found in 1889, and which has a generally agreed-on age of only 20,000 years. If Dr. Weidenreich is correct in his identification of the Keilor skull as belonging to the Wadjak people, a really ancient human type is yet to be found in Australia. A possible complication in the problem may arise from the fact that "modern" types of human skulls have been found at apparently the same levels with undoubtedly ancient, primitive skulls, in other parts of the world. Could this mean that modern types evolved early, and perhaps at several different times? Dr. Weidenreich is inclined to think not. He feels that in such cases the dating is in error and that more reliance can be placed on the skull type than on the geological level of burial.

COLOR detectives that simplify and speed up the chemical analysis of such substances as milk, metals, beer, wine and soap have been perfected in stable form at the University of Illinois. The detectives are chemical reagents that have long been known in chemical laboratories, but because of difficulties involved in compounding them have not heretofore been looked upon as stable and positive tools of chemical analysis. Chemically the reagents are known as ortho-phenanthrolines. They are so efficient that they are able to disclose the presence of one part of iron, or certain other elements, in a million parts of water. The new development at the chemical laboratory of the university is a process of producing the reagents as stable compounds capable of giving reliable reaction. Their use will permit an industrial chemist to make in 15 minutes certain analysis that under old methods might take a half day.

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SCIENCE NEWS

Science Service, Washington, D. C.

X-RAYS

PRACTICAL applications of a new basic discovery, in which x-rays and other radiations are used to alter the elastic constants and chemical properties of quartz and other crystalline substances employed in radio and radar oscillator-plates to regulate wave-lengths, were demonstrated, on April 11, to a group of scientists at the Reeves-Ely Laboratories, New York City, by Dr. Clifford Frondel, head of the company's research division.

Another interesting application of x-rays found in the course of Dr. Frondel's work is its use in changing the color of many gem stones, and some colorless stones of little value may be given intense hues. Diamonds have been colored green and golden brown with deuterons, but the cost of the treatment is large and the results frequently unpredictable, so that the method is not yet of much commercial value.

Dr. Frondel discovered recently that x-rays, and certain other types of radiation cathode, or electronic, rays and deuteron beams from a cyclotron, when allowed to pass through plates cut from certain crystalline substances, alter the mechanical strength of the material. There are accompanying changes in the color of the crystals, and their chemical reactivity also may be altered.

The x-rays or other radiations cause an interchange of electrons, Dr. Frondel explained, between the atoms composing the crystal and, by thus altering the interatomic bonding forces, change the elastic constants of the material. The effect is similar to the action of visible light in blackening photographic emulsions.

The discovery is of great theoretical interest from the viewpoint of pure science, but has already been put to practical use in the war effort. Millions of tiny plates of crystalline quartz, the size and shape of postage stamps, are used by the armed services as oscillator-plates to control radio communications. The frequency at which the radio will transmit or receive is controlled, in common types of crystals, by the thickness of the plate. They are brought to proper thickness by mechanical means, and the process is an extremely delicate operation.

By using the new x-ray irradiation technique, oscillator-plates can now be adjusted rapidly and easily to a desired frequency with a precision hitherto impossible.

Irradiation with x-rays also has been found to greatly modify the rate of solution and the chemical reactivity of crystals, and a whole new field of x-ray photochemistry is being opened up by his research.

ITEMS

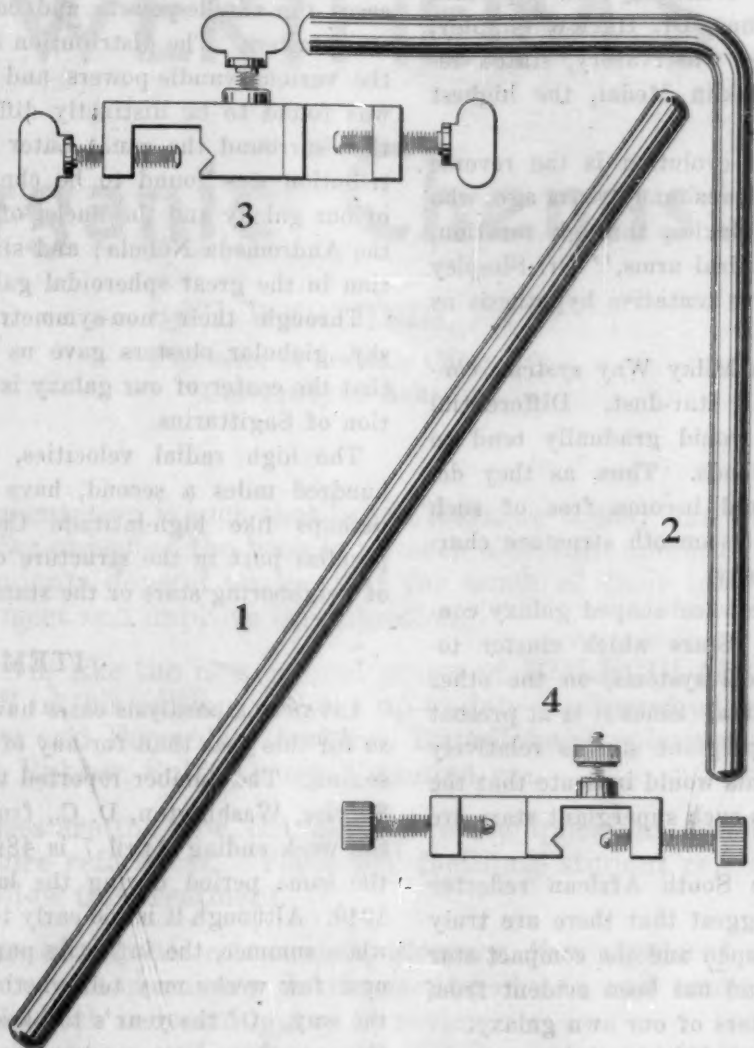
FIVE new white dwarf stars have been added to the list of known faint stars of high temperature and of a density so great as to be almost incredible, Dr. W. J. Luyten, of the University of Minnesota, and Dr. Martin Dartayet, of Cordoba Observatory, Argentina, have reported to

Harvard College Observatory. This brings the number of known white dwarf stars to about seventy-five. The newly discovered white dwarfs are located in the southern constellation of Pavo, the peacock; Phoenix; Tucana, the toucan; and two are fairly close together in the constellation of Musca, the fly. The stars were discovered when photographs taken with plates which were particularly sensitive to yellow light and those which were especially sensitive to blue light were compared. The plates were taken with the 60-inch reflecting telescope of the Cordoba Observatory.

A NEW beacon light that will burn for a year without adjustment or refueling and that can be seen for about 12 miles has been developed by the Army Air Forces as a warning light for planes. It is to be placed on the peaks of high mountains and near other hazards located in isolated areas. It may be used as a civil airway marker after the war. Known by the code name Type C-3, the new light is an acetylene-burning lantern designed for installation where electricity through power lines is not available. In operation a 400 candlepower beam is flashed for two tenths of a second, 30 times a minute. Upper and lower lenses are fitted with red filters to throw the light in a complete 360-degree circle so that it can be observed by pilots from any direction. The main burner has a three-cluster flame ignited by two constant pilot lights. Tiny holes in the base of the apparatus permit enough air to get in to keep the flame going. A ballast system prevents the light from being blown out by high winds. The beacon is controlled by a sun-valve device which consists of four metal rods that are sensitive to light. These rods expand and contract when the outside light varies, and have a compensating device to take care of temperature changes. The expansion and contraction of the rods produces energy to operate the valve which governs the flow of fuel to the main burner.

MILITARY supplies and equipment can be salvaged without damage from sunken ships or lie for weeks on island beachheads or in jungle outposts without the slightest damage from the elements, as the result of corrosion control methods developed by the Air Technical Service Command at San Antonio, Texas. This corrosion control program, expected to save the government millions of dollars, preserves parts for airplanes from damage by the elements while *en route* to the war theaters. The program provides for applications of many kinds of rust removing solvents and coatings with rust-preventives, in addition to paper and wax coatings. The treatment is designed to prevent all types of corrosion and fungus growth for at least eighteen months under any type of climatic condition. Even microscopic fingerprint moisture contains enough acid to cause corrosion of highly polished surfaces, such as engine and precision parts. Special solvents applied by pressure or with a small brush eliminate the acid that in the past has caused great losses by rendering valuable supplies useless.

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SCIENCE NEWS

Science Service, Washington, D. C.

GLOBULAR STAR CLUSTERS

WATCH-SHAPED groups of myriads of stars, with long spiral arms like those of a fiery pin-wheel, may be "young" galaxies that will eventually develop into compact globular clusters of stars, Dr. Harlow Shapley, director of the Harvard College Observatory, stated recently upon receiving the Franklin Medal, the highest award of the Franklin Institute.

"The suggested direction of evolution is the reverse of that proposed by Sir James Jeans many years ago, who assumed that the spheroidal galaxies, through rotation, become flattened and develop spiral arms," Dr. Shapley said in presenting his alternative tentative hypothesis as to how galaxies evolve.

Spiral galaxies, like our own Milky Way system, contain many clouds of stars and star-dust. Differential rotation within such galaxies would gradually tend to eliminate these clusters and clouds. Thus, as they develop, the spiral galaxies should become free of such non-uniformities and take on the smooth structure characteristic of the spheroidal galaxy.

Like our own Milky Way, the wheel-shaped galaxy contains many supergiant stars. Stars which cluster together in elliptical and spherical systems, on the other hand, are almost never supergiants. Since it is at present believed that the life of a supergiant star is relatively short, the existence of supergiants would indicate that the spirals are less developed unless such supergiant stars are still being born.

New studies made with the South African reflector of the Harvard Observatory suggest that there are truly transitional types between the open and the compact star clusters—a phenomenon that had not been evident from the studies of the globular clusters of our own galaxy.

Our own Milky Way is about 100,000 light years in thickness. Remeasurement of the distances of about 30 of the 100 globular clusters of our galaxy established the thickness of the haze of stars and clusters that surrounds the flattened watch-shaped main body of the galactic system.

Giant globular clusters are about as bright and of the same general structure as the nuclei of some of the spiral galaxies. From comparisons of the greatest of globular clusters and the smallest of the spheroidal galaxies, it is believed that clusters like the southern hemisphere groups of stars, Omega Centauri and 47 Tucanae, are partially related to such galaxies as the companions of the great Andromeda Nebula, our nearest neighbor.

The study of globular star clusters has made four major contributions to the study of the sidereal universe:

The first developed rapidly at the Harvard Observatory about fifty years ago when Professor S. I. Bailey began his extensive work in the discovery and study of variable stars in the brighter globular clusters. Eventually a dozen workers entered the field. The "cluster-type Cepheids" were linked up with the regular or classical

Cepheids into the period-luminosity relation, which has provided us the yardstick for measuring our galaxy and others.

The second somewhat revolutionary discovery concerns the candle-powers and colors of stars in globular star clusters. The distribution of the cluster stars among the various candle-powers and spectral classes (colors) was found to be distinctly different from that of stars that surround the sun. Later this globular cluster distribution was found to be characteristic of the nucleus of our galaxy and the nuclei of other spiral galaxies like the Andromeda Nebula; and similar also to the distribution in the great spheroidal galaxies.

Through their non-symmetrical distribution in the sky, globular clusters gave us our first clear indication that the center of our galaxy is very distant in the direction of Sagittarius.

The high radial velocities, frequently more than a hundred miles a second, have shown that the clusters, perhaps like high-latitude Cepheid variables, have a peculiar part in the structure of the galaxy, unlike that of neighboring stars or the stars of the Milky Way.

ITEMS

INFANTILE paralysis cases have been persistently higher so far this year than for any of the five past years at this season. The number reported to the U. S. Public Health Service, Washington, D. C., from the first of the year to the week ending April 7 is 484. The highest figure for the same period during the last five years was 377 in 1940. Although it is too early to predict what will happen when summer, the infantile paralysis season, arrives, the next few weeks may tell whether another epidemic is on the way. Of the year's total so far, about one fourth of the cases have been reported from New York State. The rest have been scattered throughout the country.

LIFE jackets and life preservers used by the armed forces and merchant marine will soon be packed with a new fibrous glass material, as the 10,000,000-pound stockpile of kapok and substitutes such as milkweed fiber and Ecuador kapok threatens to become depleted by the end of this year, according to a report of the U. S. Coast Guard. Selected as the best substitute for kapok life-jacket filler after exploratory tests had been conducted on a number of materials at the Mellon Institute of Industrial Research, fibrous glass has many superior qualities. It is fire-proof, more resistant to being packed down under compression, and does not absorb water as rapidly as kapok. Before the war, America imported up to 10,000 tons of kapok annually. Most of it came from Java, and this source of supply was cut off when that country was invaded by the Japanese. A soft, fluffy fiber, kapok is secured from the pods of the bombax tree. The clumps of fiber were removed from mature pods, cured in the sun and compressed into bales by native labor.

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Professor of Organic Chemistry
University of Arkansas

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867 Pages. \$4.00. May 1945

Laboratory Guide for Organic Chemistry—2nd Edition

This manual by Dr. Wertheim provides 169 varied experiments illustrating properties, methods of preparation, reactions of organic compounds, and a section on "spot tests." Many helpful drawings are included, and a time table for each experiment is given as a guide to the student.

24 Illus. 560 Pages. \$2.00

THE BLAKISTON COMPANY Philadelphia 5, Pa.

SCIENCE NEWS

Science Service, Washington, D. C.

GASOLINE AND DIESEL OIL OBTAINED FROM NATURAL GAS

GASOLINE and other liquid hydrocarbons may be made from natural gas at a manufacturing cost, for the gasoline, of approximately five cents a gallon, by the so-called Synthol process, according to a statement made by Paul Ryan, of the M. W. Kellogg Company of Jersey City, N. J., in which he described the various technical steps of the process. The natural gas, he states, costs about five cents a thousand cubic feet. Diesel fuel and various chemical compounds are obtained at the same time.

Seven major steps are involved in the process. They are purification, synthesis gas preparation, synthesis reaction, condensation, gas separation, stabilization and fractionation of the liquid hydrocarbon products into gasoline and diesel oil, and the separation and recovery of the liquid chemical compounds.

Sulfur and other deleterious compounds are removed in the purification, the natural gas is converted to carbon monoxide and hydrogen in the synthesis gas preparation step, and in the next step these are converted, in the presence of a selected catalyst under controlled conditions, into the desired hydrocarbons and chemical compounds.

These must be condensed into liquid form in condensers, and in the gas separator the oil layer containing the liquid hydrocarbons is removed from the water layer containing the chemical compounds. The various liquid hydrocarbons are stabilized and fractionated into gasoline and diesel oil in the last step in the process.

The plant to make the liquid hydrocarbons from natural gas should be near large gas reserves because approximately 11,000 cubic feet of gas are required to produce one barrel of liquid hydrocarbons. He stated that the Synthol process of the Kellogg Company presents for some oil companies "interesting postwar possibilities for the economic and profitable development of new uses for an old natural resource."

ITEMS

EVERY one who saw the big meteor flash across the sky on the evening of April 19 is asked to report what they saw so that astronomers can determine how large the fireball was and where the fragments, if it fell to earth, can probably be found. Reports should be sent to Dr. Charles P. Olivier, president of the American Meteor Society, Flower Observatory, Upper Darby, Pa. Each report should tell from where the person saw it, where in the sky the meteor was first seen and last seen, stating how high in the sky and direction, so that its altitude and azimuth or bearing can be calculated. Information on the meteor's train or smoke trail is particularly desired, especially its shape, changes which occurred, and which way it drifted. If any sound was heard which might have come from the meteor, please also report that.

AFTER seeing the miracle which has been performed by American industry during this war, South American young men are turning to the United States rather than

Europe for engineering education, according to Anibal Santos, formerly mechanical engineer of Empresa Electrica del Ecuador, Inc., Guayaquil, Ecuador, and now associated with the Combustion Engineering Company, speaking before the American Society of Mechanical Engineers. Only recently have South Americans begun to study engineering in North America. The problems faced by American engineers in Latin America are complicated by the fact that there are relatively few technical men there, as compared with the legal and medical professions.

A NEW aluminum lifeboat that weighs less than a wood boat and only half the weight of a steel boat of the same capacity has been approved by the U. S. Coast Guard for use on American merchant ships. It is resistant to action of such corrosive agents as salt spray, and because of its lightness reduces the weight installed on the upper decks, thereby improving the stability of the ship. Lighter-weight davits may be employed to handle the aluminum boat than those required for a steel or wood boat of the same capacity, since when loaded with the same sea rescue equipment, it weighs less than two and one-half tons. Most standard lifeboats weigh more. The equipment carried includes oars, seats for a large number of men, an axe, provisions for sustaining survivors until they are rescued, and may have an inboard motor.

ALTERNATING current electric motors of small size but tremendous strength which perform heavy-duty control jobs aboard aircraft, such as pumping fuel and air, operating propeller-feathering and wheel-retracting mechanisms, were described here to-day by Ray G. Holt, of Pesco Products Co., Cleveland, at a meeting of the Society of Automotive Engineers. The motors he referred to are three-phase 400-cycle 208-volt. Power packages consisting of small electric motors and attached mechanisms, some of "flea power" size and only an inch in diameter, have been made available for use both with electric and hydraulic aircraft control systems. The power packages are located near the devices they provide the power to operate and help to solve the serious engineering problem of transmitting great power over long distances in military aircraft.

THAT the first section of the Society of Automotive Engineers to be organized outside continental North America has been established in the Hawaiian Islands, has been reported by John A. C. Warner, general manager of the society. The Hawaiian section will be comprised of automotive engineers on Oahu and neighboring islands and active professionally in an area regarded as an important Pacific route junction of postwar air travel. The Society of Automotive Engineers was organized in 1905 to represent the interests of all automotive engineers. The activities encompass design, production and operation of vehicles and aircraft in peacetime, and in wartime the developmental research needed for military materiel produced by the automotive industry.

SCIENCE NEWS

WILEY

43 Adoptions in 1945

INTRODUCTION TO PARASITOLOGY

Seventh Edition (1944)

By ASA C. CHANDLER, *Professor of Biology, The Rice Institute*

¶ Since publication of the seventh edition of Chandler's "Introduction to Parasitology," 43 schools have adopted this textbook for the spring course of 1945. This is not, of course, an exceptional record for "Chandler," but in view of the discontinuance of many courses in the subject for the duration, it is nevertheless a substantial one. Frequent revisions have kept this book constantly up to date, and additions and improvements have increased the value of Dr. Chandler's book as a teaching aid. A few typical comments from users of this book will indicate some of the characteristics that particularly appeal to teachers:—

"I have always felt that Chandler's book was one of the very best of the textbooks in parasitology. It is especially suited for beginning students since he has an aptitude for making complicated things simple but still accurate."

Professor W. W. Cort
Johns Hopkins University

"This book is the only good introduction to human parasitology and has been the only one in previous editions. The author has rightly understood the point of view of college students in their desire to have clear, relatively simple and accurate information in this important field. The seventh edition is no exception to this general understanding."

Professor Ernest Carroll Faust
Tulane University

"This has long been a standard textbook and the new edition will be welcomed by all of us. It should play a very useful part in developing the increased interest in Parasitology. Dr. Chandler has incorporated in this edition practically all the new information that has appeared since the previous edition, and he is to be congratulated on the thoroughness and soundness with which he has selected from the great mass of material that has appeared."

Professor Robert Matheson
Cornell University

"Experience has led to the conclusion that Chandler's book is still the leading choice for undergraduates and is thoroughly suitable for graduate work as well. I am adopting it as the text for my course this spring. The outstanding features of Chandler's book include a solid biological outlook . . . constant reference to recent literature, and a readable quality that is unique among parasitology texts."

Professor Ralph W. Macy
Reed College

December 1944

716 pages

55 $\frac{1}{8}$ by 85 $\frac{1}{8}$

\$5.00

JOHN WILEY & SONS, Inc., 440-4th Ave., New York 16, N. Y.

SCIENCE NEWS

Science Service, Washington, D. C.

ALUMINUM

RECOVERING valuable aluminum for re-use from crushed war-weary, crashed or obsolete planes has been speeded up by a new process that literally dissolves the aluminum from whole sections of these planes. This new method, developed by the Aluminum Company of America in co-operation with the Air Technical Service Command, eliminates all need for sorting metals before the aluminum is melted down and gives an end product of pure, high-grade aluminum ready for reprocessing. The aluminum obtained from alloys and other metals coated with aluminum is for all intents and purposes the same as aluminum manufactured from bauxite.

Whole sections of wings and fuselage are placed in a bath of caustic soda. This caustic soda dissolves the aluminum in the planes, while any steel nuts and bolts, rivets, copper piping, bronze bushings, rubber or other non-aluminum parts are not attacked by the caustic and remain in solid form. Aluminum alloying elements are not attacked by the caustic, and as is the case with other non-aluminum parts they can be removed readily from the sludge. Thus scrapped planes are taken apart quickly by chemicals, instead of by tedious hand labor.

After filtering out the solid impurities from the sludge, the aluminum-bearing liquor is transformed into pure aluminum oxide by the Bayer process. This is accomplished by pumping the liquor into precipitating towers as high as six-story buildings and allowing it to stand and cool. In time, crystals of aluminum hydroxide begin to settle out. These crystals are removed and washed to free them of caustic soda. Then they are heated white hot in large rotating kilns to drive off any moisture and leave commercially pure aluminum oxide or alumina. The caustic soda recovered can be re-used.

The aluminum oxide can be processed into any desired form by standard methods, about which there is nothing new. Other parts, such as rivets, rubber and so on, can also be salvaged.

The chemical stripping of aluminum from wrecked planes makes possible the conservation of the country's high-grade bauxite reserves and man-hours required to mine bauxite. If this process had been available at the time of the scrap aluminum drive in 1942, when housewives turned in to the government their aluminum pots, pans and skillets, those cooking utensils could have been processed and used in aircraft construction. As it was, they were of little value, since the large number of different mixtures and alloys of aluminum used in cooking utensils made it impossible to identify and sort the vast quantity turned in. Most of this material was melted down into low-grade metal.—ROBERT N. FARR.

ITEMS

THE effects of changes in population, including war casualties, on the make-up of groups seeking employment is being studied at the Scripps Foundation for Research in Population, Miami University, under a grant from the

Rockefeller Foundation. The total population of the United States would increase by about 25,000,000 between 1940 and 1970, the Scripps scientists have estimated. This estimate was worked out on the assumption of medium fertility, medium mortality, no immigration and no war losses. By 1970 the population of the Soviet Union would increase by about 77,000,000 over that of 1940, according to an estimate quoted on the review of the work of the foundation by Dr. Raymond B. Fosdick, president of the foundation. During the same period France and England would each show a decrease of about 4,000,000. These estimates also are based on the assumption of an orderly development of past population changes and do not allow for war losses or boundary changes. Facts to show the meaning of these and other changes in population, in terms of international trade, migration and agreements and also in terms of standards of living and cultural advancement or degradation within a country are being sought in Rockefeller-supported studies at the Scripps Foundation and at the Office of Population Research at Princeton University.

A NEW, but important, instrument has been added to the already confusingly crowded instrument panels of multi-engine aircraft. Known as the engine performance calculator, it merits its position because it can show the pilot or flight engineer by a glance at a plastic dial how any engine is performing. It eliminates complicated mathematical computations which, if not accurate, might result in the plane's failing to reach its destination, since the distance a multi-engine plane can fly depends largely upon the efficient operation of its engines. Developed by H. B. Riggs, a flight engineer with Consolidated Vultee Aircraft Corporation, the calculator is set in accordance with engine speed and manifold pressure instrument indications. From this is computed such important information as fuel consumption, horsepower and cylinder pressure. The idea for the calculator came to Mr. Riggs while he was trying to keep a malfunctioning patrol bomber engine in operation during a long flight over the Pacific.

THREE new standard samples of hydrocarbons are now available from the National Bureau of Standards, bringing the total number to forty-six of these national standards of particular value in rubber, petroleum and chemical industries. They have been prepared and certified for use in calibrating spectrometers and other analytical instruments and apparatus used in the laboratories of these industries. The first of these standard samples were made available in January, 1944, as a contribution to the war effort. The purity of each is stated on the certificate accompanying them. They are also certified relative to values of refractive index and density, and some for calorimetric heat of combustion. This is for use in establishing heating values of gasoline and other volatile liquid fuels.

**WILEY**

May 1945 Publications

PRINCIPLES OF RADIO

By KEITH HENNEY, *Editor, "Electronics"*

An elementary presentation of radio principles, revised to include material on such important topics as wave guides, velocity modulation tubes, frequency modulation, Klystrons, ultra high frequency techniques and apparatus. Emphasis is placed on recent developments and future methods. As in former editions, the book is written for the student with little background in radio, and the language is clear and non-technical. Problems are given to show the application of the principles explained.

Fifth edition; 542 pages; 5½ by 7½; \$3.50

PLANE AND SPHERICAL TRIGONOMETRY

By H. A. SIMMONS, *Professor of Mathematics, Northwestern University*, and GREEN-VILLE D. GORE, *Professor of Mathematics, Central Y.M.C.A. College of Chicago*

This greatly enlarged second edition begins with the trigonometric functions of the general angle, instead of the positive acute angle, and includes precisely the solid geometry needed for the study of spherical trigonometry. The book contains not only theoretical spherical trigonometry, but a large number of applications, including introductory navigation and certain elementary problems of astronomy. There are also chapters on *Complex Numbers* and the *Slide Rule*.

Second edition; Approximately 511 pages; 5½ by 8½; Probable price \$2.75

DYNAMIC METEOROLOGY

By J. HOLMBOE, W. GUSTIN, and G. FORSYTHE; *all at the Department of Meteorology, University of California at Los Angeles*

The theoretical background needed by the practical meteorologist, this textbook contains only that material considered indispensable for the meteorologist and weather forecaster. This is probably the only book that starts from the fundamental principles of physics and develops the tools of thermodynamics and hydrodynamics needed for a thorough understanding of atmospheric processes. Self-contained and presupposing only a general knowledge of physics and calculus, this book introduces and develops the methods of vector algebra and calculus as most naturally expressing the concepts of atmospheric processes.

378 pages; 5½ by 8½; \$4.50

SCIENTIFIC SOCIETIES IN THE UNITED STATES

By RALPH S. BATES, *formerly of the History Department, Massachusetts Institute of Technology*

The only book that gives a complete survey of the evolution of American scientific societies during the past two and a half centuries, covering national, state and local organizations. Proceedings, transactions and other publications of hundreds of scientific societies were used in the preparation of this book. The relation of such historical factors as national growth, to the formation of scientific societies, is discussed in the book.

246 pages; 5½ by 8½; \$3.50

MAINSPRINGS OF CIVILIZATION

By ELLSWORTH HUNTINGTON, *Research Associate in Geography, Yale University*

The three parts of this book take up first the general problem of evolution from geological times down to the present, with special emphasis on the stages preparing the way for the development of civilization. Part two deals with heredity, and discusses the selective action of migration, and the problems of race. The final section takes up the effect of physical environment on the evolution of civilization, emphasizing climate, diet, and density of population as basic factors.

660 pages; 5½ by 8½; \$4.75

JOHN WILEY & SONS, Inc., 440-4th Ave., New York 16, N. Y.

SCIENCE NEWS

Science Service, Washington, D. C.

THE TOTAL ECLIPSE OF THE SUN

AMATEURS seeing the total eclipse of the sun on July 9 can help astronomers by paying special attention to the moon's shadow and the horizon glow. Descriptions of these and an estimate of the general brightness at mid-totality should be sent to Dr. John Q. Stewart, of the Princeton University Observatory.

The sunrise eclipse, which can best be seen from parts of Idaho and Montana, furnishes an opportunity for observations without instruments, such as have not yet been made satisfactorily with a low sun, according to an article by Dr. Stewart in *Sky and Telescope*.

Illumination during an eclipse seen near sunrise or sunset differs from that when the sun is high overhead in two important ways.

First, the cone of the moon's shadow, lying nearly horizontal, intersects the earth's surface near sunrise or sunset in an elongated ellipse instead of in a circle as with a vertical shadow cone. The ellipse is elongated toward and away from the rising or setting sun. Toward and away from the sun the shadow edge is relatively distant and the whole aspect of the sky will rapidly change as the shadow passes. In the two directions athwart the ellipse the glow will extend high above the horizon and show little or no reddening because the shadow edge there is close at hand.

The second way a sunrise eclipse differs from a noonday eclipse is that at exact sunrise the shadow is not moving horizontally eastward, but is falling through the air. Near the sunrise point the axis of the shadow is moving down from interplanetary space.

To make such observations, local knowledge of the terrain is needed to pick a site where there is an unobstructed view across lower mountains in all directions, and especially toward the rising sun. It would doubtless be necessary to camp the night before near the top of a favorable summit.

The sun rises totally eclipsed at 6:14 A.M., MWT, about 10 miles southeasterly from Cascade, Idaho. Then the shadow passes about eight miles north of Salmon, Idaho, thence five miles south of Butte, Mont., two miles south of Saco in northeastern Montana, and one mile south of Opheim, which is eight miles below the Canadian border. Thus there are a number of places from which such observations may be made.

Because little attention has been paid to the study of the general illumination in an eclipse shadow, a large eclipse shadow was more or less expected to result in an unusually dark eclipse. Thus Dr. Stewart and James Stokley, now with the General Electric Company, were surprised to notice that although the circular shadow of the eclipse of June 8, 1937, which they observed near noon, was nearly 180 miles in diameter, the eclipse became no darker than in a summer afternoon's thunderstorm.

This year Dr. Stewart and Mr. Stokley, who observed the other eclipse from a freighter in the Pacific Ocean, plan to pay particular attention to the shadow, probably

seeing it from the top of some mountain in Montana. Dr. Stewart is anxious for amateur astronomers to send him a report of their findings on the eclipse.

"Advance rehearsals are a necessity! The eclipse will not reoccur," Dr. Stewart warns those interested in making the observations. "Inspect the proposed site of your station and use your imagination to suggest all possible preparations."

"Record the weather conditions which prevail during the eclipse. State types of clouds, if identified. Note the color of the sky around the sun. State the distance at which hills and the like can be seen, as an indication of the purity of the air. Even if there is a high overcast the shadow may be apparent on the clouds."

"Be continuously on the alert for unexpected phenomena, and write everything down immediately after totality."

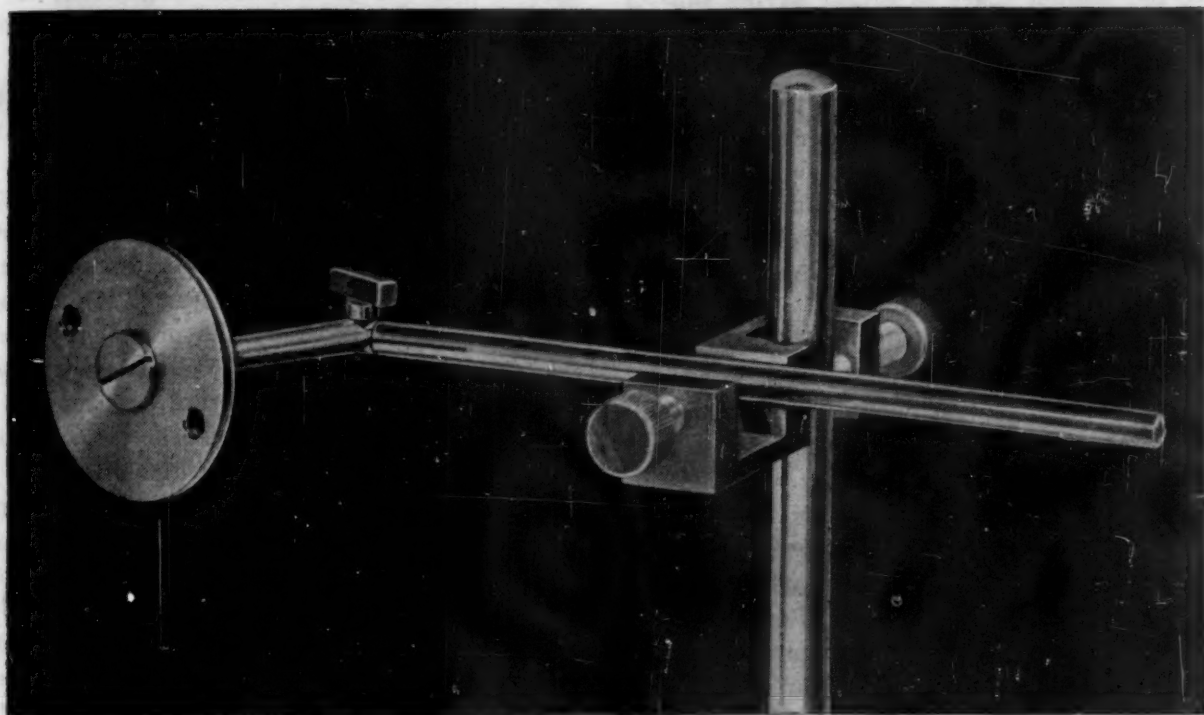
ITEMS

THE Azerbaijan Academy of Sciences at Baku, the oil center, has been added to the roster of the world's scientific bodies. Geologists, physicists, biologists and other scientists and technologists are now at work exploring the raw materials and working out new methods and processes for the industries and agriculture of this republic of the U.S.S.R. which lies on the eastern side of the Caucasian Mountains. Chromite, the ore of chromium needed for steel alloying, as well as ores of cobalt, barium and aluminum have been discovered. Cotton yields have been increased. The autonomous academy replaces a branch of the U.S.S.R. Academy, and the new organization starts with fifteen academicians under the presidency of Dr. M. Markazimov.

American Aviation reports that after July 1 weather maps for aviation will be the same all over the world, when the United States Weather Bureau replaces the presently used constant-level charts with constant-pressure upper-air charts as a basis for its domestic aero weather forecasts. The constant-pressure charts were developed through the combined efforts of the Army, Navy and Weather Bureau for world-wide combat and transport operations. Since the armed forces are using the constant-pressure charts, the Weather Bureau decided to adopt this type of chart for domestic forecast, in the belief that it will coordinate the continuity of weather maps over the world and increase the efficiency of upper air analysis. The domestic airlines, through the Meteorological Committee of the Air Transport Association, have opposed the move on the basis that airline operations in this country are accustomed to the use of the current type of chart. Therefore, the Weather Bureau will continue to report the constant-level types of charts on its teletype system for spot weather reporting until next year. This should give the airlines sufficient time to become adapted to the new method.

For the Physiological Laboratory

Pulley with Jointed Arm



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SCIENCE NEWS

Science Service, Washington, D. C.

DISCOVERY OF A SUPERNOVA

CHANCE played a role, as it often does in scientific research, in the discovery of a supernova in the constellation of Canes Venatici, or the Hunting Dogs, near the Big Dipper, at Mount Wilson Observatory at Pasadena.

Discovery of a supernova—a star which temporarily may become 100 million times as bright as the sun—is always news to astronomers. But in this case, the story behind the news is as interesting as the discovery itself.

On the evening of April 6, Milton L. Humason was preparing to photograph the spectrum of the spiral nebula Messier 51 with the 100-inch telescope of the Mount Wilson Observatory. The spiral known as Messier 51 consists of two parts: a main spiral to which is attached a small satellite. It was this satellite spiral which Mr. Humason intended to photograph.

Although he had not observed this particular nebula for three years, his attention was immediately attracted to a faint star near the central nucleus which he could not recall having seen before. At first he was inclined to dismiss the object, believing his memory was at fault. Yet somehow he felt sure there was no star at that position three years ago. If so, it was probably a supernova. The conviction became so strong that he determined to make a check at the earliest opportunity. Sure enough—examination next morning of old photographs of Messier 51 failed to reveal a star near the center of the satellite spiral.

The surest way to decide if the star was really a supernova or not would be from its spectrum. Upon the following night therefore Mr. Humason secured a photograph which told the whole story. The star was found to have strong bands in the red region of its spectrum typical of supernova about 65 days past their maximum brilliancy.

"It was certainly fortunate that I had Messier 51 down on my observing program for the night of April 6," Mr. Humason said. "For it was fading so rapidly that I should probably have overlooked it a few weeks later. The fact that a supernova appears in a spiral nebula only once in about every 400 years makes the coincidence seem all the more remarkable. Also, if the star had not been so close to the central nucleus I feel sure I should never have noticed it."—ROBERT S. RICHARDSON.

ITEMS

KOPFF'S periodic comet has been rediscovered by Henry L. Gielas, astronomer at Lowell Observatory, who recently located the famous Pons-Winnecke comet. The comet is of the 13th magnitude, far too faint to be seen with the naked eye. The object was quite diffuse, with a nucleus. Nothing was reported about its tail. Kopff's comet was located in the constellation of Libra. According to a telegram sent by Dr. V. M. Slipher, of the Lowell Observatory, Flagstaff, Ariz., to Harvard Observatory, its posi-

tion on May 7 was at right ascension 15 hours, 21 minutes, 11.9 seconds; declination minus 24 degrees, 21 minutes, 21 seconds. Its daily motion was found to be 36 seconds of time west and 8 minutes of arc north. Kopff's comet was first discovered in 1906, by a German astronomer whose name it bears. It was last seen in 1939, at which time it was also of the 13th magnitude. It was then located in the constellation of Aquarius, the water-carrier.

THE newest escape device for fighter pilots to be used in case of serious emergency is a catapult seat that drops the pilot through the floor of his plane when he presses a release lever and depresses a treadle bar with his feet. Designed for use with pusher-type planes where the propeller is located behind the cockpit instead of in front, the catapult seat throws a pilot clear of the airplane so that he will not be injured by the propeller. Developed by engineers of the Consolidated Vultee Aircraft Corporation, the catapult is also a miniature elevator, for non-emergency use. On the ground it can be extended beneath the fuselage or cockpit nacelle of the aircraft. When the pilot sits down and pulls a lever, it will rise smoothly into the airplane cockpit. This will make it possible to save space that is now needed to give the pilot an entrance to his plane. After a flight, the pilot adjusts the seat level and lowers himself to the ground. This new development may lead to wider experimentation with pusher type airplanes. Aeronautical engineers have long known that pusher-type airplanes can be extremely efficient, due to the fact that the most vital wing contours are not disturbed when engines and propellers are situated behind the wing surfaces.

WITH a new self-sealing pipe coupling you can now disconnect pipes without the loss of liquid or gas contents; not even a drip gets out, and no air or dirt can get into the line. The secret is two automatic valves that seal off the ends of the line as they are uncoupled. It is particularly handy in preventing spilling of inflammable or corrosive liquids which may be carried in pipes. Developed by the Exactor Control Company, Ltd., London, and reported in *The Engineer*, the coupling can be used for systems carrying liquids or gases at pressures up to 200 pounds per square inch. The bore of the coupling ranges between one quarter inch to twelve inches. The metal of which the coupling is made varies, depending upon the use to which it is to be put. Light alloys are used for aircraft, heavier metals for ordinary use, and stainless steel for chemicals whose purity must be guarded and for liquids to be used for human consumption. As the outer ring of the coupling is unscrewed, springs inside the union gradually force synthetic rubber valves into valve seats, sealing off the two ends before they are uncoupled. In addition to normal screw couplings, bayonet fittings and other quick-release methods may be adapted to the self-sealing principle.

WILEY

Now in the Fifth Edition . . .

PRINCIPLES OF RADIO

By KEITH HENNEY, Editor, "Electronics"

The fifth edition of this textbook has been revised to include the latest developments in the field of radio. As in previous editions the book is written for the student with little background in radio, and the language is clear and non-technical. Problems likely to be encountered in actual practice are given to show the application of the principles explained.

Beginning with the fundamental principles of electricity, this book develops gradually the subject of radio practice. The values of currents, voltages, etc. are fully treated. Numerous specific examples, experiments and problems are given in this edition, and the book is well illustrated and supplemented with drawings, diagrams, and photographs of actual apparatus. The experiments discussed have all been worked out in the laboratory; they are not theoretical.

For sixteen years "Henney" has furnished the student in radio work exactly the background he needs; this fifth edition contains the complete, up-to-the-minute information necessary for a thorough understanding of radio.

NEW in this edition:

New material on wave guides, velocity modulation tubes, frequency modulation, Klystrons;

On ultra high frequency techniques, and apparatus; new chapters on measuring instruments, magnetic circuits;

On Kirchhoff's laws—on power factor, filter circuits, differentiating and integrating circuits;

On pulses, transients, square waves, voltage and current regulator tubes;

On filter design for power supply, tuning indicators, horn radiators, magnetrons, vacuum tube voltmeters, cathode ray oscillographs.

Fifth edition

May 1945

534 pages

55 $\frac{1}{8}$ by 7 $\frac{1}{8}$

\$3.50

JOHN WILEY & SONS, Inc., 440-4th Ave., New York 16, N. Y.

SCIENCE NEWS

*Science Service, Washington, D. C.*THE ALLOCATION OF FREQUENCIES IN
THE RADIO SPECTRUM

AFTER several months of deliberation the Federal Communications Commission has finally made up its mind how it will allocate space in the radio spectrum to standard broadcasting, television, airplane radio, police and other services. The stumbling-block in making final the FCC proposals published last January were the long-drawnout objections registered by owners and operators of Frequency Modulation (FM) radio stations. FM radio is staticless broadcasting.

No final decision has yet been reached by the FCC regarding the place in the radio spectrum that will finally be set aside for FM or for the space below 25 megacycles. Three possible sections of the waveband are under consideration, and during the coming summer months, scientists of the FCC will experiment with FM broadcasting in these three parts of the spectrum to determine which of the three is best for FM radio. These experiments will be conducted at the field offices of the FCC, from which FM broadcasts will originate. Cellulose tape recording equipment that can record sound for several hours without stopping will be placed at various spots in the area around each FM station. Continuous recordings will be made day and night. From these recordings, engineers will be able to find out just which section of the spectrum permits FM broadcasting with the least interference.

The spectrum is still congested, although every service that asked for space in the airplanes got at least a part of what it asked for. In making the decisions, the commissioners engaged in a give-and-take study, giving more space to services which proved by their testimony that they needed more frequencies in order to carry out their operations in the public interest, and to new services that promise to extend the use of radio to the benefit of more people.

Probably the most important new radio service is the Citizens Radiocommunication Service, which will make it possible for every U. S. citizen to have his own broadcasting station in the form of walkie-talkie or handie-talkie equipment. Regulations covering licensing and operation of the equipment will be simple and easy to comply with. The only stipulation made by the FCC is that no charge may be made for messages carried over the air in this portion of the spectrum.

Other new services that have heretofore never been licensed are radio for railroads; rural radio communication for farmers that will permit them to reach telephone communication lines and make use of telephone service even though they have no telephones; and mobile radio for buses and cross-country trucks.

The allocations extend to 30,000,000 kilocycles in the spectrum, farther than the FCC has ever before licensed. This is by no means the upper limit of the radio spectrum, and in the future the FCC may allocate channels to services beyond that super-high frequency range.—ROBERT N. FARR.

ITEMS

WATER for drinking purposes is sterilized, to destroy microorganisms and free it of all biological contaminations, by a treatment, just patented, in which it first subjected to positive pressure and moderate heat, and then injected into a high vacuum. The patent was granted James A. Camelford, of Cleveland, who has assigned it to the Buckeye Laboratories Corporation. In the process, contaminated water is strained or filtered to remove solid impurities, and then passed through a high-pressure pump which puts a pressure of from 1,000 to 4,000 pounds per square inch on it. It is heated to about 125 degrees Fahrenheit, then sprayed through a nozzle into a vessel maintained at as nearly a perfect vacuum as possible. The result is a palatable water relatively free of biological contaminations.

DIATOMACEOUS earth will be used to filter water in new purification units shipped to the armed forces in the Pacific as a result of tests conducted by the Engineering Board, Fort Belvoir, Va. The new filter, experiments showed, not only removes the cysts of amoebic dysentery but also filters out the blood flukes prevalent in Philippine waters. Another improvement featured by the new purification units is the glass-fiber tank which, coated with Buna S rubber, replaces the old canvas type. It will not mildew and is little affected by climatic changes. Where the canvas tank loses a considerable quantity of water before the fibers swell to waterproof proportions, the new type is waterproof and fills at once. It is presumed that U. S. troops going directly to the Pacific field from Europe will take their old-style purification units with them. Plans are being made to equip them with the newer type.

RADAR, the radio echo device that can pick up targets through the clouds and spot airplanes miles away, may confuse homing pigeons and cause mild headaches among men who operate the device. Studies of the effects of microwaves and ultra-high frequency short waves upon pigeons and men are being made by Major Otto Meyer and Lieutenant Commander L. E. Daily, a Navy doctor. While no evidence of physical damage has been discovered among the men who operate the Navy's radar devices, some of the men reported mild headaches and the feeling that their faces were flushed. These symptoms are reported to have ceased when they were more than four feet from the radio wave emissions of the transmitting equipment or the receiving antennae. These studies have disproved the theory that radar waves might cause baldness, and that radar emissions interfere with the ability of men to father children. Periodic physical examinations of radar operators are being continued, as is the practice of shielding the men from the radar waves. The long waves of ordinary radio do not seem to bother pigeons, but they appear to be somewhat upset by the short radar waves. The Signal Corps is investigating the matter because officials hope the study may show where pigeons can find their way home.

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SCIENCE NEWS

Science Service, Washington, D. C.

THE SCARCITY OF SCIENTIFIC AND TECHNICAL MEN

WAR has all but stopped basic, academic research in chemistry and has stopped the training of new research chemists and chemical engineers, Dr. Roger Adams, leading organic chemist, head of the department of chemistry of the University of Illinois and head of chemical work of the U. S. Office of Scientific Research and Development, charged in a recent radio talk.

"Basic scientific research finds new truths, and supplies new material upon which much of the industrial progress of the future depends," Dr. Adams said. "Years will be required before basic research activity again reaches its prewar level."

"The war also has stopped the training of new research chemists and chemical engineers. Thousands of academic and industrial chemists have been drafted into the armed services with only a few of them in a position where they can use their technical knowledge."

"The research organizations associated with industry, which find new products and upon which industry relies for expansion and for creation of new jobs, are at a low ebb. There is no possibility that they can recover quickly in the near future. This is a matter of great concern to the scientists and should be to the public, for only by years of patient research by trained and competent investigators can we maintain the high level of achievement in the field of science, on which is based position of eminence among nations."

Dr. Adams talked during the intermission of the New York Philharmonic Symphony broadcast sponsored by the United States Rubber Company.

R. J. DEARBORN, president of Texaco Development Corporation, reports that expansion of industrial research after the war by small companies will be limited by scarcity of scientific and technical men.

"One of the most serious problems of industry is the deficit in fully trained young professional men for post-war employment," Mr. Dearborn declared. "This country is faced with a period during which the demands of war-stimulated technology will not be met by an adequate supply of scientists and engineers. As research is the backbone of industrial progress and creation of jobs in the postwar era, the lack of a sufficient number of well-trained scientists will have a profound effect on invention and plans of corporations to provide for many new products."

War has prevented the normal flow of trained young men from the colleges, and a great number of trained men, now in the armed services and in war jobs, will find it difficult to return to their old work due to disuse of their technical abilities. Training of scientists in the colleges has almost come to a standstill, and it will be 1950 before a normal flow of technical graduates can be expected.

Government will probably compete with industry for scientific personnel after the war, Mr. Dearborn stated, since the government will probably intensify its research

activities. In addition, there will be a great demand for United States technical personnel abroad, due to the tremendous reconstruction work which will be needed. Still other trained persons will go to colleges and universities as teachers.

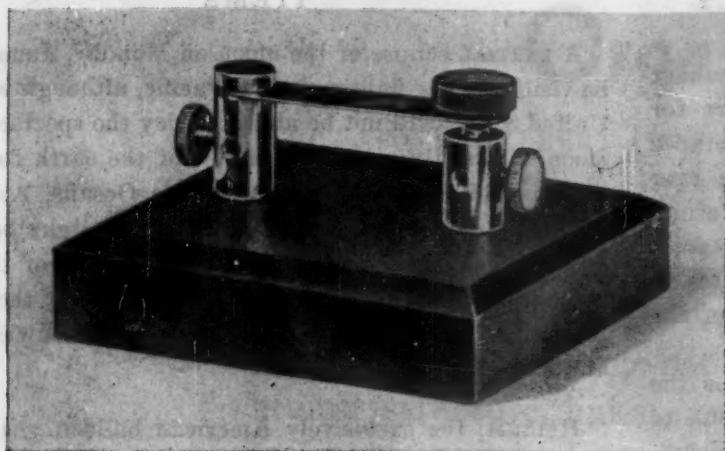
ITEMS

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THE two hundred and twentieth anniversary celebration of the Soviet Academy of Sciences, to be held late in June, will, in addition to meetings, include a popular festival honoring the scientists of the U.S.S.R. and what they have done to serve their nation in peace and war. The academy consists now of 145 academies, including some of the leading figures in Soviet science, among them Dr. V. Komarov, botanist, who is president; Dr. P. Kapitsa, physicist; Dr. N. Semenov, chemist; Dr. I. Vinogradov, mathematician; Dr. I. Orbeli, physiologist, and Dr. N. Burdenko, surgeon. Fifty-seven institutes or sections equivalent to institutes are conducted by the Soviet Academy, with a total staff of more than 5,000 scientific and technical workers. The work is divided into eight departments: Physics and mathematics, chemistry, geology and geography, biology, technology, history and philosophy, economics and law, literature and language.

THE largest British airplane yet to take to the air is the 53-ton four-engined Shetland Flying Boat that could fly from London to Bombay, about 4,650 miles, non-stop at 184 miles an hour. It is larger and has a longer range than the American-built Martin "Mars," the largest U. S. flying boat. The airplane is a double-deck ship with accommodations for 70 passengers and a crew of 11, and is fully air-conditioned. There are three main compartments as well as a promenade on the after upper deck, a fully equipped kitchen and rest rooms. The new giant of the sky, built by Short Brothers, is powered by four 2,500 horsepower Bristol Centaurus air-cooled, 18-cylinder engines. These powerful engines turn four-bladed propellers which have blades measuring 15 feet, 9 inches in length. The wingspan of the Shetland is 150 feet, greater than of a B-29 Superfortress, and it has an overall length of 110 feet. Fuel tanks carry more than 6,000 gallons of gasoline and 320 gallons of oil.

A NEW fuel substitute for gasoline that gives one-fourth more power in a properly designed internal-combustion engine is reported by Donald B. Brooks, of the National Bureau of Standards. A blend of certain non-hydrocarbons, the fuel, if used in an ordinary gasoline engine, may give up to 5 per cent. more power than gasoline. Mr. Brooks stated that the components of the new blend are ethyl alcohol, diethyl ether, acetone and butanol. These can also be used "straight" in some cases. His conclusions are based upon tests of substitute motor fuels conducted in a precision single-cylinder variable compression engine in the bureau's automotive laboratory at the request of the Foreign Economic Administration of the Office for Emergency Management.



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SCIENCE NEWS

Science Service, Washington, D. C.

CONSTRUCTION OF AN EMERGENCY
TELEPHONE LINE

PHOTOGRAPHIC surveys, made from planes flying about 20,000 feet from the earth, are responsible in part for the rapidity with which an inland emergency long-distance telephone line was constructed in 1942, stretching over 1,300 miles from Washington State to southern California. The project was undertaken as a war measure to assure telephone communication between Pacific coast states in case Japanese activities cut the existing lines nearer the ocean.

The route of this war-constructed line is east of the Pacific coast ranges extending from Yakima, Wash., to The Dalles and Klamath Falls, Ore., Reno and Las Vegas, Nev., and ending at Danby, Calif. From The Dalles to Klamath Falls, poles of an existing line were used for the wires of the new line; for the other 892 miles, poles and wires had to be erected.

Information relative to this war undertaking is now made public in the *Bell Telephone Magazine*, published for the supervisory forces of the American Telephone and Telegraph Company. After the decision to construct the line, the first step was to survey a route from Klamath Falls to Reno. Two planes were used, one flying south from Klamath Falls, the other going northward from Reno. The pre-determined altitude of the planes was from 17,000 to 22,000 feet.

The aerial photographs proved very satisfactory, showing details of the terrain so perfectly that locations for the line could be easily selected and plotted. So closely did the completed line follow the path selected from the pictorial survey, that 95 per cent. of the original route was unchanged.

Building this line, particularly because of the rapidity with which the work had to proceed, was a gigantic undertaking. The survey for the line started on April 25, 1942, and the last stake driven on August 20. The first pole was set on June 15. The first step of construction work, which was to set poles with crossarms and hardware, string wire for the top arm of the main lead, and build two side leads, was completed on August 31. Other construction was completed on October 15. The final clean-up work was out of the way by November 20, and the project office from which the construction was directed was closed on December 1.

A difficult part of the project was to assemble labor, experienced telephone construction men, the necessary trucks, machine diggers and other machinery, and to obtain poles, crosswires, hardware and wires. A roadway had to be constructed along the location for practically the entire distance for trucks delivering poles and equipment. Poles, creosoted and ready to be put in the ground, were brought by railroad from Texas and Mississippi. Other equipment was obtained wherever possible. Engineers, experienced telephone men and operators were borrowed from the various Bell companies.

ITEMS

A PARTIAL eclipse of the moon on Monday, June 25, will be visible to our fighters in the Pacific, although we in the United States will not be able to enjoy the spectacle. The moon will partly enter the shadow of the earth for people in the Pacific, Indian and Antarctic Oceans, Asia, Australia and southeast Africa. Instead of light being cut off from the entire moon, only 86.4 per cent. of the moon at most will be eclipsed. The moon will enter the shadow proper, or umbra, at about 1:37 P.M., Greenwich Time, and will leave it at 4:51 P.M.

HELIUM, the exclusively American balloon gas, can be used economically to inflate the huge tires of passenger airliners, it has been found by engineers of the Consolidated Vultee Aircraft Corporation of San Diego, Calif. Use of this gas instead of air saves weight and permits an increased payload. Air required to fill the tires would weigh 180 pounds, as compared with 26 pounds for helium. Tests have proved that the puncture-proof tubes will hold the lighter helium gas at the required pressure. An ample supply of helium is available, as the government is now producing more than is needed in balloons and dirigibles, and is releasing some for other uses.

AMERICAN scientific museums and universities will soon have opportunity to get seeds and herbarium specimens of Russian plants, in exchange for American botanical material. Large-scale preparations for this scientific cooperation are being made at the Central Botanical Gardens in Leningrad, the Academy of Sciences of the U.S.S.R. has cabled to Science Service. Greenhouses and other buildings of the gardens, which suffered severely during the long siege of Leningrad, are being rebuilt, and more than 700 acres of new land have been added to the working area. Approximately 10,000 trees, shrubs and flowers are already growing in the nurseries. The Leningrad botanical institution traces its origin to a garden of medicinal plants set out in 1713 under the direction of Czar Peter the Great.

BLOOD plasma was successfully fired in artillery shells to Allied troops cut off by Nazis in Europe, reports Major General Paul R. Hawley, surgeon to the European Theater of Operations, in a report appearing in the *Marine Corps Gazette*. This adds a new item to the list of many ways in which blood plasma has been delivered to American fighting men. In the past, plasma has gone to the front by plane, ship, on horseback and in jeeps, and it has been dropped from the air in parachutes. General Hawley reports also that pre-invasion estimates of the amount of plasma that would be required to fill the needs of the Army were far too low. Instead of one transfusion required for every five men wounded, battle experience has shown the need for one transfusion for every two men wounded.

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SCIENCE NEWS

Science Service, Washington, D. C.

THE TOTAL ECLIPSE OF THE SUN

THE total eclipse of the sun on July 9 will be studied by professional and amateur astronomers from observation points along its path across the United States, Canada, Norway, Sweden, Finland and Russia.

Great interest in the eclipse has been reported in the Scandinavian countries and the U.S.S.R., a number of observation stations having been located along its path. The government's request that civilians do only essential traveling here in the United States has kept many plans from materializing, but a number of small groups expect to go to Idaho, Montana and into Canada to watch the moon blot out the sun early on Monday morning, July 9.

Several problems to be investigated have been outlined by Professor Bertil Lindblad, of the Stockholm Observatory, and a few American astronomers plan to cooperate. The problems are largely astrophysical, dealing with the flash spectrum and the polarization of the light of the corona.

Fire lookouts of the U. S. Forest Service expect to study the advancing shadow of the moon from mountain peaks in Montana and Idaho in response to a request from Dr. John Q. Stewart, of Princeton University Observatory. Dr. Stewart, who has outlined several observations which amateurs can make without special apparatus that will be of help to astronomers, will himself observe the eclipse with James Stokley, now with the General Electric Company, from the top of one of the Montana mountains.

A number of small groups of professional and amateur astronomers are planning to go to Canada, where the total eclipse will last longer and the sun will be higher in the sky when eclipsed than in the United States (the sun will rise eclipsed for observers in Cascade, Idaho, not far from Boise).

Ladd Observatory of Brown University, in cooperation with the "Skyscrapers," local amateur astronomical society, will send an expedition to a point near Regina, Saskatchewan. The principal studies to be made by the group, reports Professor Charles H. Smiley, chairman of the department of astronomy of the university, will be the precise timing of the four contacts of the eclipse and the determination of the absolute brightness of the outer corona by a series of photometric measures.

Dr. Roy K. Marshall, director of Fels Planetarium of the Franklin Institute, plans to go to Wolseley, Saskatchewan, taking with him, along with other delicate instruments, a Ross Fecker camera belonging to the Flower Observatory and a photoheliostat of the Cook Observatory, both of the University of Pennsylvania. Because of the short duration of totality, each camera will take only one picture, either long or short exposure, thus avoiding confusion and the waste of precious seconds in pulling and replacing slides and changing plate-holders.

A party from the Milwaukee Astronomical Society plans to make some extensive observations southwest of Pine River, Manitoba, probably in Duck Mountain Forest Preserve. The main piece of equipment will be an ob-

jective-prism camera to photograph the flash spectrum at second and third contacts, which will be accurately timed with Bureau of Standards time signals.

ITEMS

FIRE lookouts of the U. S. Forest Service will help astronomers by observing the July 9 eclipse. About 60 foresters in lookout towers on mountain peaks in Montana and Idaho, some of the peaks 10,000 to 12,000 feet above sea level, will study the advancing shadow of the moon. For them the shadow will sweep down for a minute or less at about 6:14 A.M., Mountain War Time, or 5:14 A.M., Pacific War Time. A questionnaire sent by Dr. John Q. Stewart, of Princeton University Observatory, suggests that three kinds of observations relating to the shadow would be helpful. Its motion in the sky can be reported in detail; the degrees of darkness on the ground estimated; and stars identified during totality, particularly the faintest stars. The total eclipse is over so quickly (30 seconds) that no single inexperienced observer will have time to carry out more than one observation. Although Dr. Stewart suggests that everyone spare a few seconds for a glance at the beautiful corona, he points out that observations of the corona by amateurs are not likely to be of scientific value, whereas adequate observations of the shadow are very desirable.

MOUNTAIN leather, a type of asbestos that has been only a museum curiosity in the past, is now found adaptable to industrial uses, particularly in filtering, sound-proofing and shock-absorbing materials. A deposit of limited size has been discovered near the entrance to Glacier Bay, Alaska, and experiments, conducted by the U. S. Bureau of Mines, give promise of possible wide commercial use. This native material is known to geologists as paligorskite. When dry it is light in weight, tough, resembles buckskin and tears somewhat like heavy cardboard. Upon wetting it absorbs considerable water, swells and becomes soft. It can be torn easily, resembles paper pulp, and is slimy to the touch. In this condition it can probably be converted into a pulp in conventional paper-mill beaters, and then formed into many lightweight, acid- and fire-proof products.

ETHYL chloride, the chemical used to make tetraethyl lead that takes the knock out of gasoline, will soon be produced by a new process in a plant under construction at Baton Rouge. The process, developed by the Ethyl Corporation, yields ethyl chloride by reacting chlorine with waste products from one of the corporation's other ethyl chloride plants. The chemical has many uses in addition to its service in gasoline and in high octane aviation fuel, several of which are connected with the war effort. The chlorine for the new process is produced by breaking common salt electrically into its parts, sodium and chlorine. The sodium produced is used in the manufacture of tetraethyl lead after it is combined with metallic lead to form a lead-sodium alloy.

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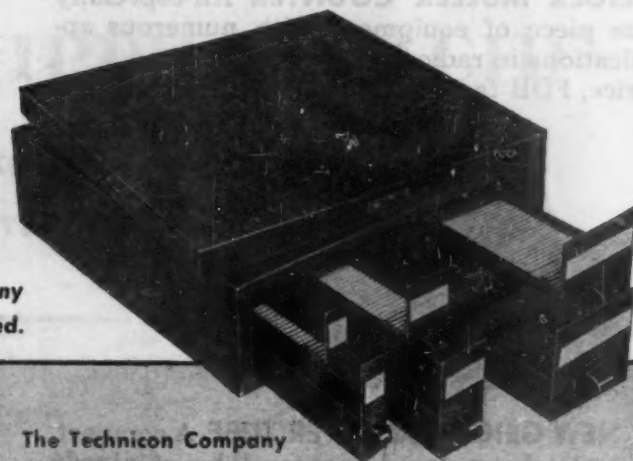
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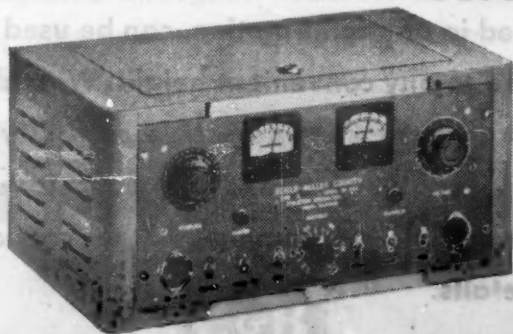
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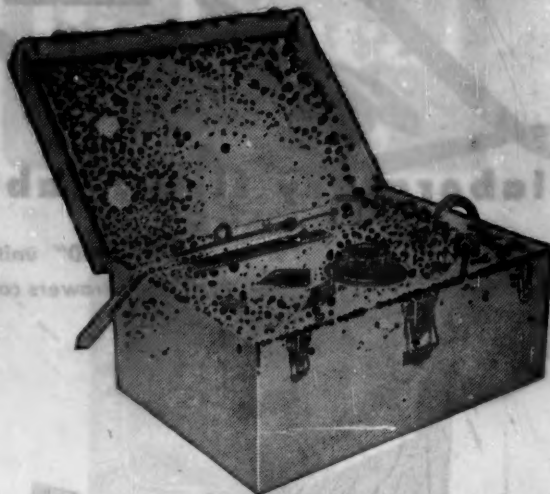


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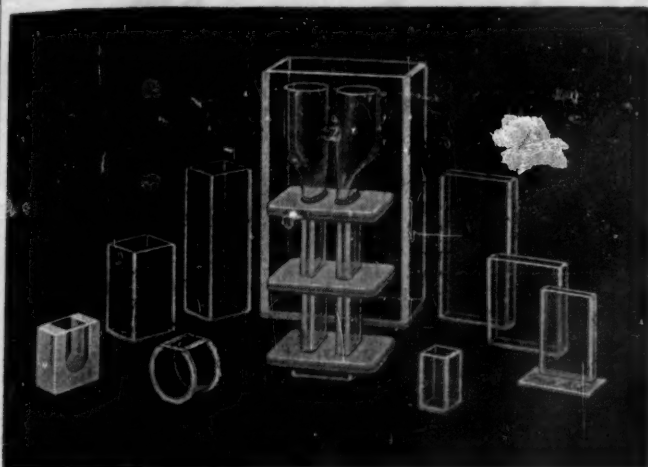
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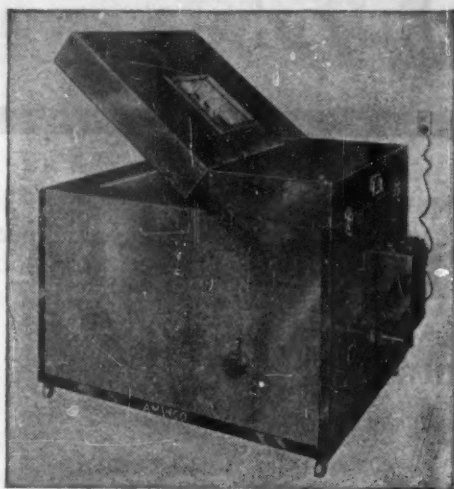
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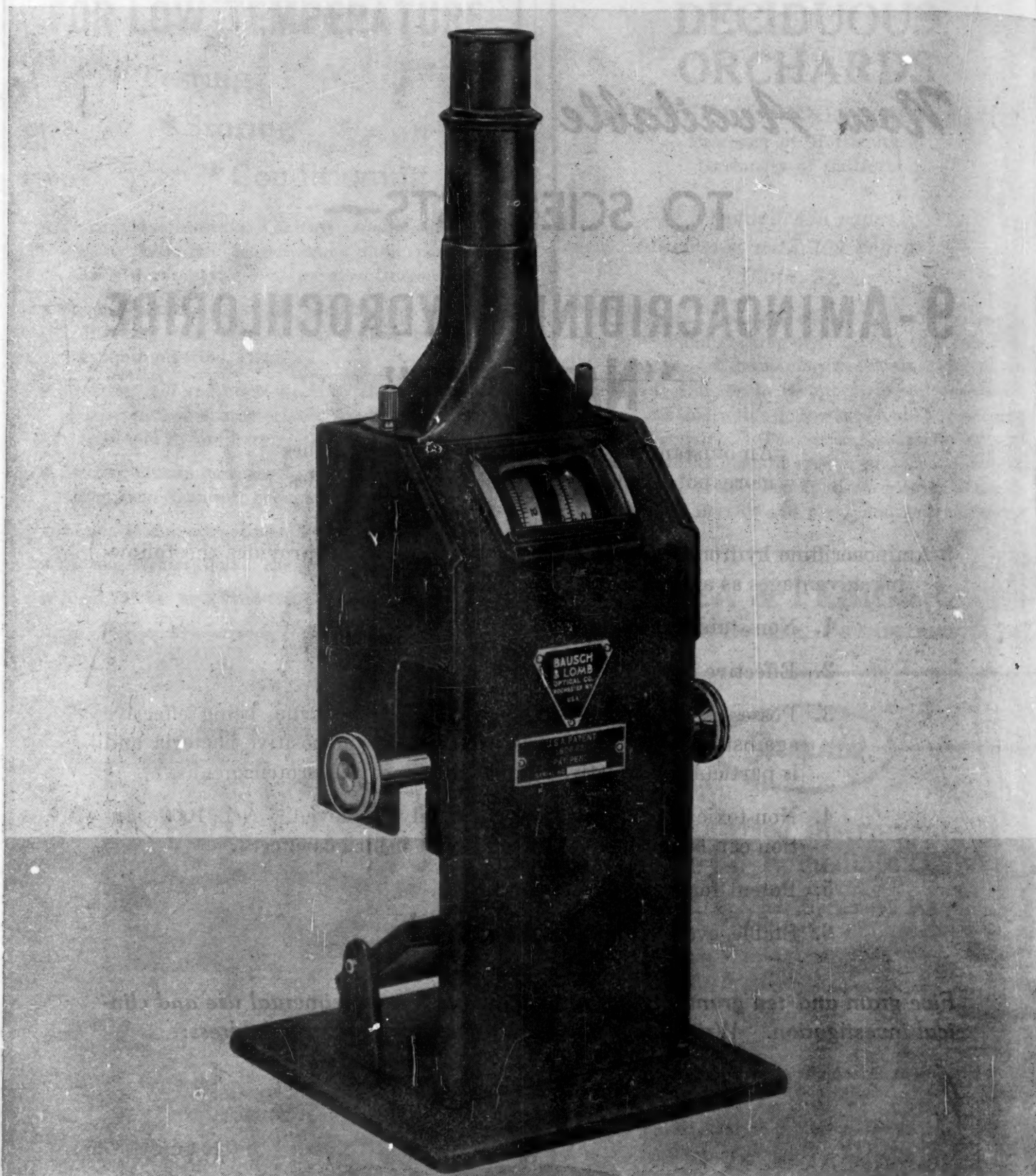
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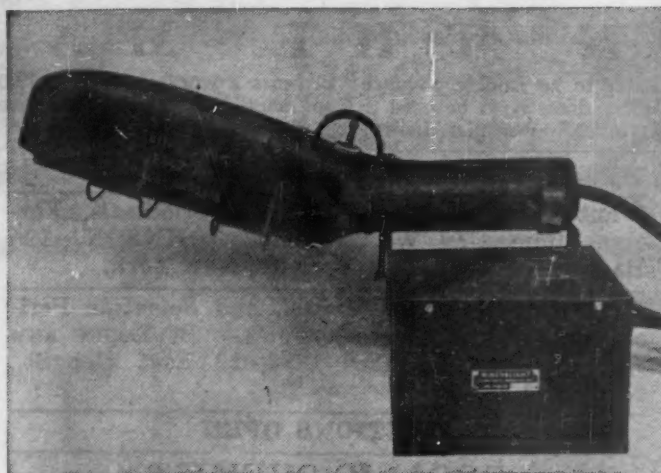
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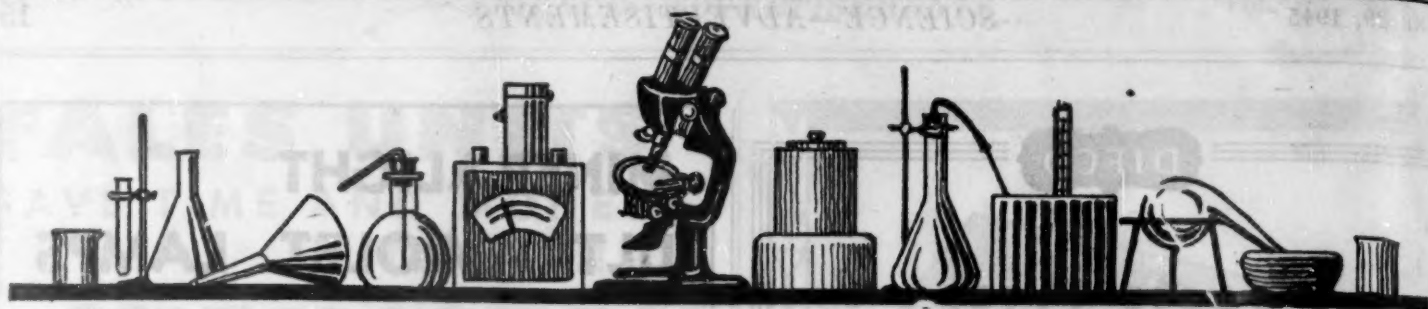
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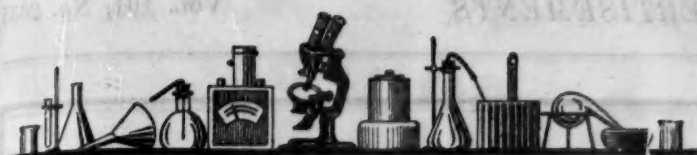
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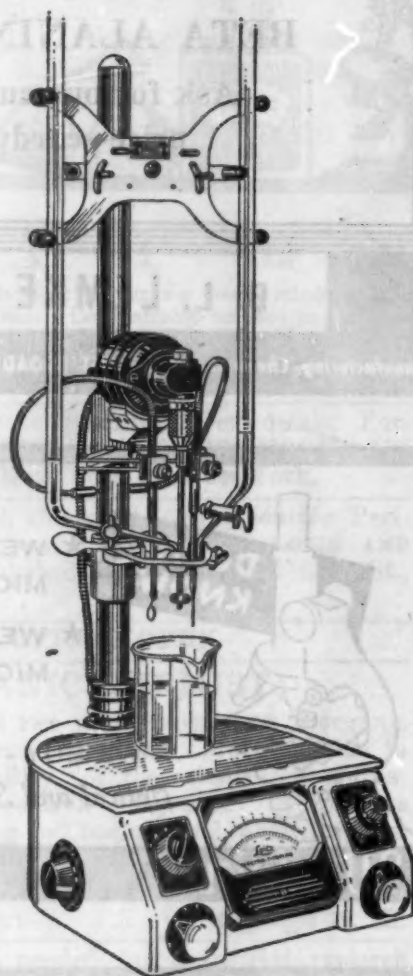
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